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NATURAL HISTORY

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1929

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A HAITIAN RHINOCEROS IGUANA

JOURNAL OF THE AMERICAN
MUSEUM OF NATURAL HISTORY
NEW YORK, N. Y.

THE AMERICAN MUSEUM OF NATURAL HISTORY

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VOLUME XXIX
NUMBER 5

NATURAL HISTORY

SEPT.-OCT.
1929

The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
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Published bimonthly by The American Museum of Natural History, New York, N. Y. Subscription price \$3.00 a year.

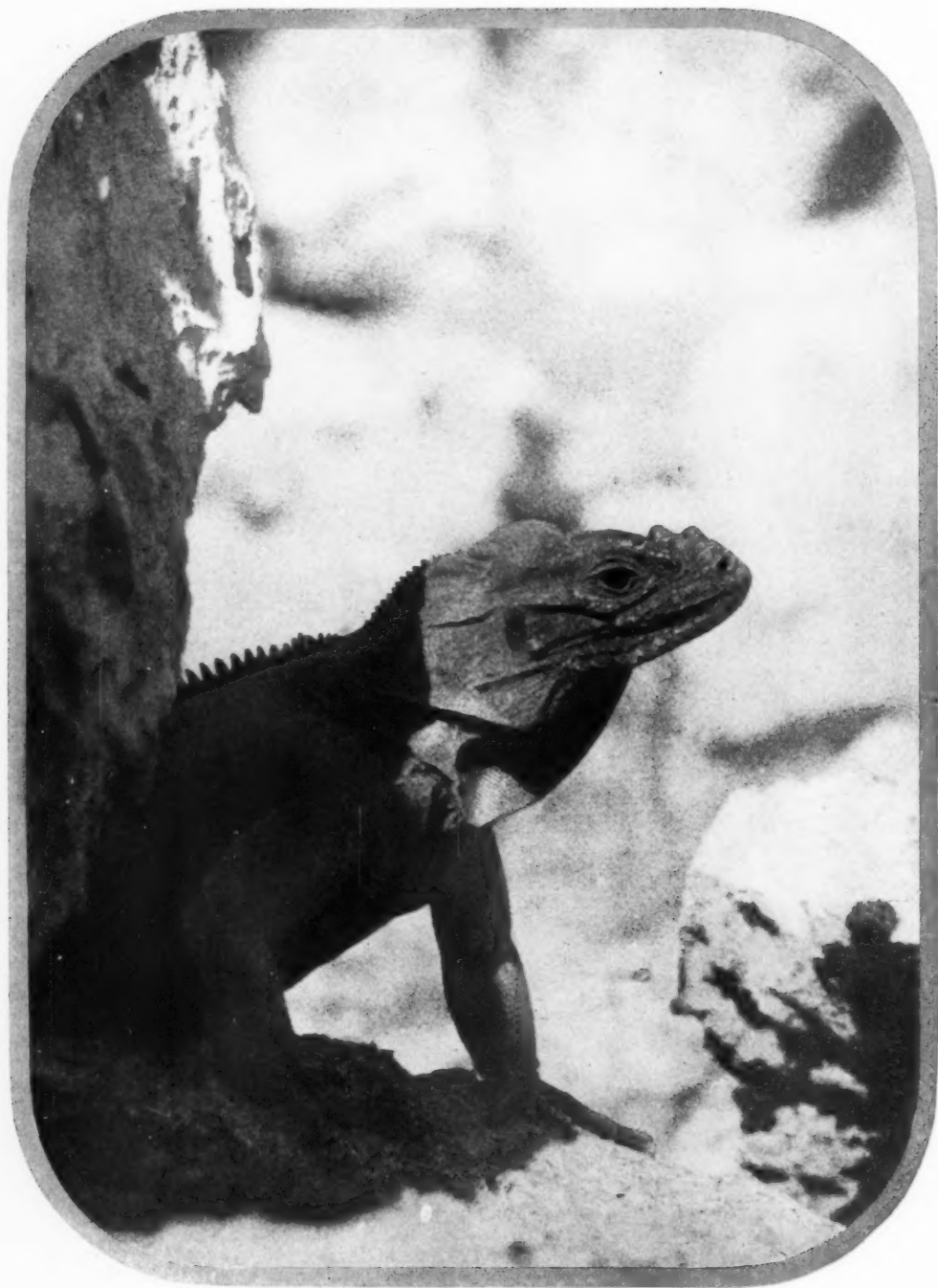
Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership.

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

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THE RHINOCEROS IGUANA

This largest of the West Indian lizards claws its burrows in the coral ledges on the islands off the coast of Haiti. With head encased in grotesquely weird plates, little glinting eyes, great crest of dorsal spines, and long black claws, this creature is strongly reminiscent of a dinosaur

See "Lizard Hunting in the Black Republic," Page 451

VOLUME
XXIX

NATURAL HISTORY

NUMBER
FIVE

SEPTEMBER-OCTOBER, 1929



LIZARD HUNTING IN THE BLACK REPUBLIC

Making Motion Pictures of Rhinoceros Iguanas on the Island of La Petite Gonaives
off the Coast of Haiti. Hunting Buried Lizard Eggs and Making Other
Reptile Studies

By GILBERT C. KLINGEL

WITH PHOTOGRAPHS BY THE AUTHOR

IN the American Museum of Natural History there is a habitat group of the rhinoceros iguana, a striking West Indian lizard between four and five feet in length, which has been so named because of the three spikes on its snout. I was so much impressed with the group that I decided some years ago to become better acquainted with this beast if opportunity afforded. Last winter I started to try my luck, not in Santo Domingo where the group material was collected, but in Haiti, the western end of the Island of Hispaniola.

The day of the rhinoceros iguana is almost over. On the Haitian-Dominican mainland it is rapidly becoming extinct. In the desert land of Haiti, near St. Marc and Gonaives, it once occurred in great numbers. There today it is seen only on rare occasions. In the Dominican Republic its haunts are being converted into canefields and plantation land. True, it may still be found in goodly numbers in Haiti, especially around Anse a Pitre and

a few other localities, but its doom is inevitable. Only on small islands off the coast does it still flourish. But even here a shooting party could destroy the last remnant of these curious lizards in a few days.

I decided to investigate first La Petite Gonaives, a small inhabited island in the blue Gulf of Gonaives, just south of the larger island of La Gonaives. As a result of the good services of my friend, the Collector of Customs, we engaged a native sailboat and a captain, and made preparations for a ten-day trip.

Late in the afternoon we glided into the mangrove-bordered harbor of Anse a Galets and dropped anchor. The village consisted of a few thatch huts and the Gendarmerie Headquarters. Lieutenant Wirkus, in charge of the native police, is an American marine officer, and the only permanent white resident of the place. He has under his control some hundred thousand blacks who are said to have crowned him "King" of the island. His



APPROACHING THE CAMERA BLIND

The rhinoceros iguana is primarily herbivorous, and banana peels and mangoes placed before the camera blind proved to be a great attraction to the iguanas of La Petite Gonaives

home and the Gendarmerie are the only substantial buildings on the whole island.

We passed a pleasant evening, enjoying the hospitality of Lieutenant Wirkus, and left the next morning for the little island to the south. Jagged coral heads protruded above the blue waters of the bay, and we soon found it advisable to keep a sharp watch for those just beneath the surface. Our native captain claimed, before leaving, that he was familiar with these waters, but I soon discovered that he knew neither the channel nor the way to manage his boat. As we approached the fringing reef of the island, the situation became strained and without waiting for further remarks from the captain, I took the tiller and headed for the south end of La Gonaives. Several hours later we rounded Point Fantasque, the extreme tip of the island, and there pictured in vivid greens and browns, against a background of blue sky and still bluer sea, lay the little

island of La Petite Gonaives. It is formed of coral and is so small that it could be "crossed in a hop, skip and jump" as the gendarme lieutenant had told us. However, it is far more interesting than its big brother island to the north.

Our little boat nosed its way into a diminutive harbor, frightening six sleepy pelicans which were eying us disdainfully. We ran our bow well up on a little strip of shell-strewn sand that served as the beach for the two or three native fishermen who had their huts near by. The entire village, a mere handful of ragged men, came down to see their unexpected visitors. In answer to our inquiry for "layzah," the patois name for the rhinoceros iguana, one of the fellows volunteered to guide us across the little island. A few feet from the village we came abruptly upon eight of the beasts we were seeking, which dashed away upon our approach. It was thus obvious that



SUSPICIOUS

Sometimes the great brutes would come within a few feet of the lens. One fellow sneaked around to the back of the blind and looked in

we could not obtain pictures of them without a blind. Returning to the boat, we stripped it of its sails and, when these were draped over the slabs of glaring coral, our improvised concealment looked far less conspicuous than I had imagined it would. We had brought some bananas and mangoes for bait, but after our hours of hard work in the midst of the blistering coral, the sight of this luscious fruit was too much for our powers of resistance and we decided to eat the bananas and use the peelings for bait.

Hardly had we settled ourselves within our blind before a half score of the ungainly iguanas swept down upon the banana peels. The temperature was gradually rising under the sail and soon it became stifling. The great brutes came nearer and nearer until they were within a few feet of the lens of my motion picture camera. One grotesque fellow even

walked around the blind to the opening in the rear and looked in upon us. I made a wild grab for him with my hands but he was off like a flash. The remainder of the lizard company dashed away but soon came back and eyed our blind suspiciously. They looked like so many dinosaurs,—certainly *Stegosaurus* or *Tyrannosaurus* could have seemed no more weird,—the great horns on their snouts, the spines along their backs, the sharp black claws, and those little glinting eyes always staring at us gave us a thrill that we shall not forget for many days.

We had arrived in La Petite Gonaïves too late for the egg-laying season, and hence, after a week of searching for the eggs and additional life-history facts, we gave up and returned to the Haitian mainland.

Haiti is one of the most densely populated areas in the world. Though it is



GONAIVES

The trade winds blow from the Atlantic and deposit their moisture on the eastern slopes of these hills, consequently the country about Gonaives, on the western side of the hills, is comparatively arid, a fortunate circumstance for the lizards which swarm in the lowlands back of the town

but one third the size of the Dominican Republic, it has more than three times the population. While the natives are quite picturesque and very interesting, to one engaged in nature study they are sometimes extremely annoying. Wherever we went there was a gang trailing along to see what was going to happen. To get rid of them was almost impossible, for as soon as one crowd dispersed another collected. We once constructed a blind for observation but had to give it up in disgust. The natives hung around like leeches. Yet, they were so willing to help and so good-natured that we could not help but like them. They have a sense of humor and as a general rule are very courteous. Although extremely poverty stricken and decrepit in appearance, they are far

from being the mystical and vicious people that so many writers like to picture them. In fact, Haiti today, for all its voodoo and mystery, is one of the most peaceful spots on earth.

Further work in Haiti was begun in earnest near St. Marc, some 200 kilometers north of Port au Prince. As we walked across the arid hills, thousands of dragon flies seemed to dart at us from all sides. The reason soon became painfully apparent. They were attracted by the mosquitoes with which the district was infested. During a short jaunt into the hills our arms and legs became black with the pests. Finally, we could stand it no longer; we broke into a run and, dashing out upon the beach, we stripped and plunged into the water. For two



ON THE ALERT

The rhinoceros iguana receives its name from the three horns on its snout. Both sexes bear these structures, which function merely as ornaments, as they are not used in fighting or in burrowing. In fact, they would seem to be distinct hindrances in climbing among the coral cliffs. The iguanas of Petite Gonaives had their horns well worn from rubbing between the rocks



THE FISHING VILLAGE OF LA PETITE GONAÎVES

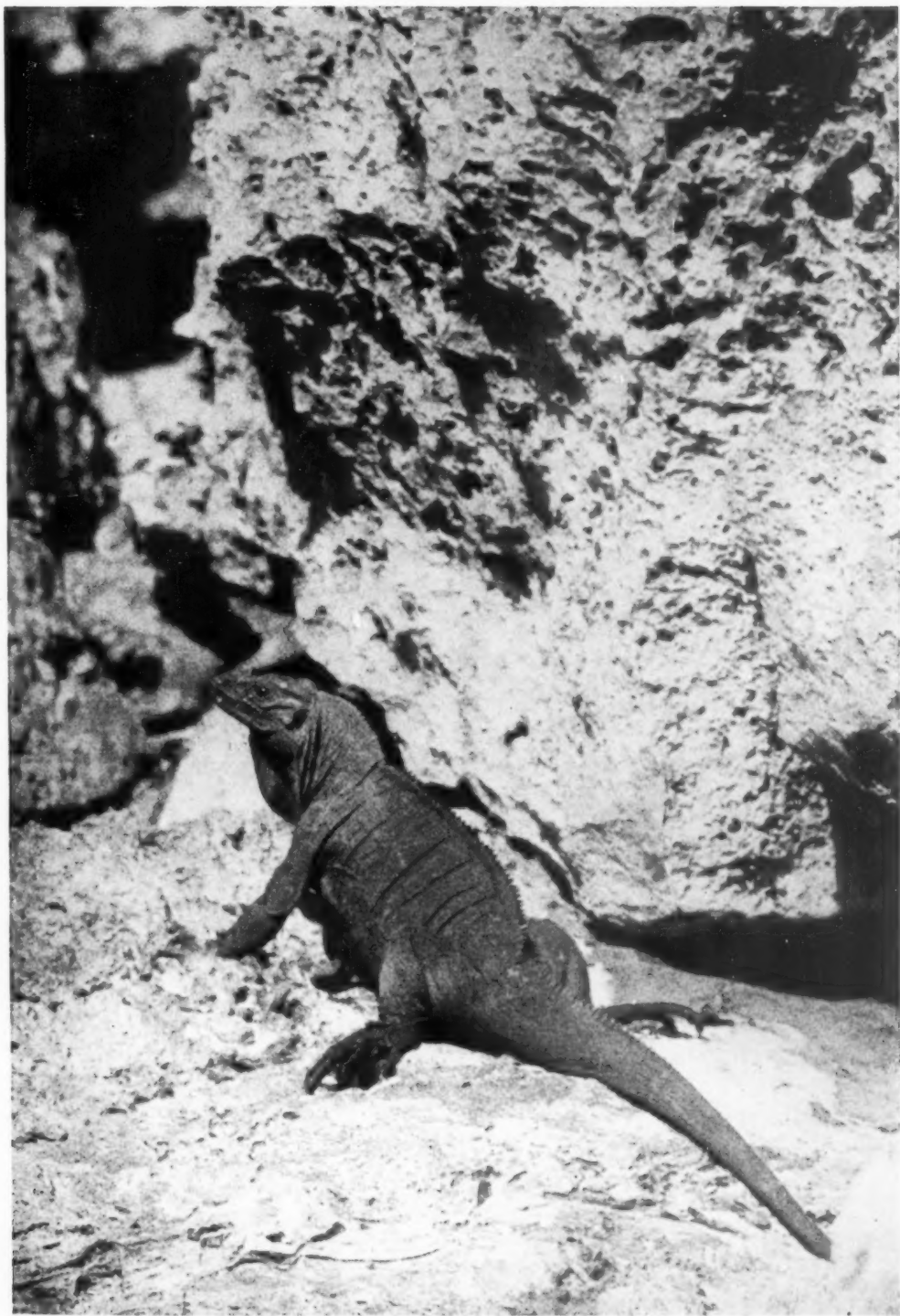
The only inhabitants of La Petite Gonaïves other than the rhinoceros iguanas are a few fishermen, together with their families and pigs

days we were thus tormented and then suddenly the mosquitoes disappeared and we were left to work in peace. We were never again bothered by noxious insects.

Our attention at St. Marc was soon attracted by the "mabouya," large sharp-snouted lizards which are common inhabitants of the Haitian roadside. These lizards, known as *Ameiva chrysolæma*, are among the most conspicuous lizards of Haiti. They have bright yellow stripes and polka-dots, and they live frequently in colonies near the rivers. As they are very nervous creatures, they are hard to approach and, when startled, they dash through the brush with apparent disregard for the thorns and brambles.

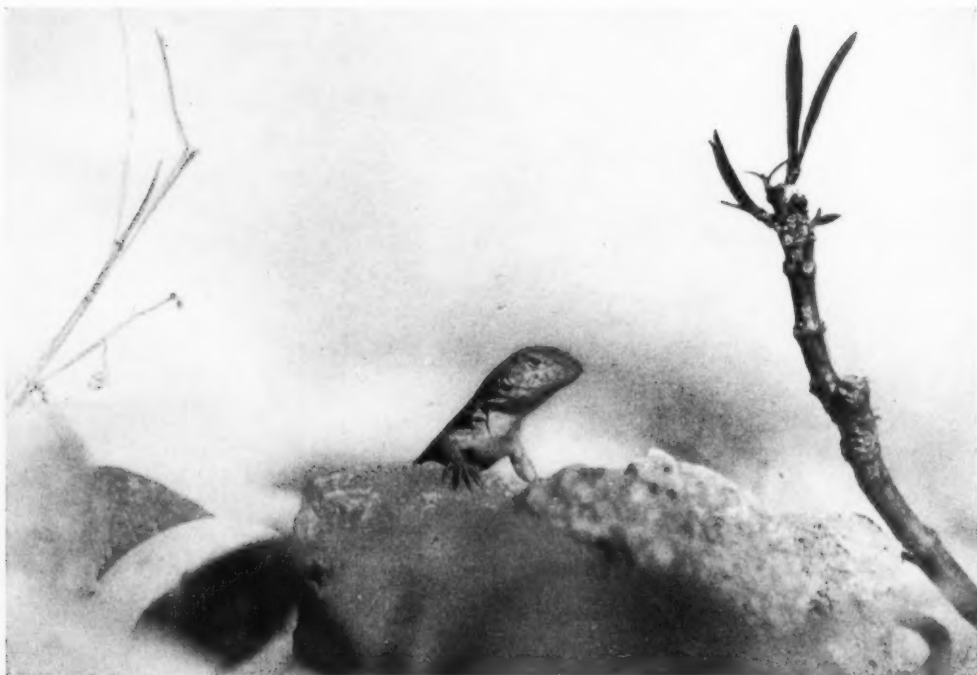
We were particularly interested in finding the eggs of *Ameiva*, so, for the better part of a week we searched over the valley back of St. Marc and pried into all kinds of burrows. As often as not we uncovered great ugly tarantulas. It is a queer sensation to thrust your arm into a hole and connect with a big hairy spider.

Fortunately we were never bitten. The eggs, however, eluded our most careful search. The tunnels into which we dug invariably ended in blank walls. By the end of the fifth day we were but little better off than when we had started, save that we had accumulated a number of notes on burrowing habits. On the following morning, however, we located a colony in a bank at the mouth of a short ravine. The holes in the bank were, to all appearances, the same as other burrows we had worked, but excavation showed them to be quite different. They were all placed in the same stratum of earth and their mouths formed a horizontal line along the face of the cliff. Several of these holes were larger than their neighbors. We chose one and dug. It ran straight into the bank for three feet and then widened into a large hollow or cavity. There it apparently came to an end. We looked rather hopelessly at each other, but acting upon a hunch, I had my native boy dig farther. He was thus engaged when I noticed that the end of his



THE HOME OF THE IGUANA

La Petite Gonaives is seamed with crevices. At the hunters' slightest movement the great iguanas would dash off and disappear among the coral crags. The tough hides of the rhinoceros iguana seemed to be impervious to the sharp coral edges, which quickly tore to shreds the hunters' shoes



A CURLY-TAILED LIZARD INVESTIGATES

The male *Leiocephalus schreibersii* is radiant in its livery of pink and green, but the female shown here wears a somber dress of grays and browns. The significance of the adornment of the male is not clear, for during courtship the females pay scant attention to the opposite sex



HAITIAN RUM

Ox cart on the road to St. Marc. Most of the native cane is used in the making of rum, very little being turned into sugar. In many cases the cane is ground in the same mills tha' the French colonists used more than 100 years ago

pick had suddenly become stained. Frantically yelling to him to stop, I seized a trowel and carefully cleared away the earth. In a few moments there came to light five eggs, four a beautiful white and one hopelessly crushed. The crushed egg contained a well developed, if somewhat mashed, embryo. The eggs had been laid in a little cavity just large enough to hold them and then had been walled in with a hard packed plug of earth. We carefully placed them in a container and continued digging. Now that the secret was out it was easy. From that burrow we took two more clutches and from the colony we collected a total of five. They were packed in moist wood pulp and rushed to the Marine Post Office in Port au Prince, whence they finally reached the American Museum.

These excavations and later study revealed an interesting group of facts. We found that there were two distinct types

of *Ameiva* colonies; one for shelter and retreat and another for purposes of propagation. The shelter burrows were occupied by either males or females, though only a single specimen occupied a tunnel. The propagation burrows were communal and were made use of by a large number of pregnant females, which left as soon as the eggs were laid. The young lizards when hatched, struggle through the layer of dirt that separates them from the outside world, without any assistance from their parents whatsoever. How they ever claw their way out without dying of suffocation en route, is something of a mystery.

One afternoon I was stretched out upon the ground, taking it easy, when I saw an interesting incident in the life of *Ameiva*. All around were strewn thousands of little yellow flowers whose bright petals raised themselves but an inch or so above the soil. They were constantly



CACTI ON THE ROAD TO ST. MARC

Haiti includes both desert and jungle. The expedition confined its efforts to the more arid regions, where lizard life was at its maximum. The officer is an American marine stationed at St. Marc



ON THE BEACH AT ST. MARC

Coconut chips proved to be the favorite hiding place of the *Leiocephalus schreibersii*, one of the "curly tailed" lizards of Haiti. These lizards receive their name from the fact that they frequently curl their tails up on their backs when preparing to run

visited by many bees, wasps, and other insects. As I watched, a lizard came into view, a full grown *Ameiva*. It was not rambling aimlessly around as is their usual wont, but was darting in a most businesslike fashion from yellow blossom to blossom, seizing the unfortunate insects that feasted thereon. In a moment it dawned upon me that this lizard had associated yellow flowers with the presence

of food, and now, instead of hunting his food, he was merely dashing from one yellow flower to another. Such powers of association in a mammal would not be surprising, but in so lowly a creature as a lizard, it was remarkable to find these mental powers so well advanced.

Another time, while I was trying to photograph an *Ameiva*, I managed to approach quite close to the beast without



**SWIFT RUNNERS
OF THE HAITIAN
ROADSIDE**

Working out for the first time the life story of this lizard, *Ameiva chrysolæma*, was one of the accomplishments of Mr. Klingel's expedition

HEADS DOWN

The Haitian chameleon, *Anolis cybotes*, hunts insects on roadside fences and trees. It frequently lies in wait with head down on the shady side of posts or trees



making it aware of my presence. I was about to press the shutter trigger when I noticed that its attention was attracted by something. Turning, I saw a good-sized cricket resting among the dead leaves that littered the ground. The insect was a full yard away from the lizard and was concealed from it by a high barrier of sticks and leaves. It made a slight noise and in a flash *Ameiva* had cleared the

obstruction and seized the unfortunate cricket. The performance was remarkable, because *Ameiva* jumped directly to the spot where its prey was sitting, although it could not see it.

As the days slipped into weeks and the weeks into months our study progressed evenly and smoothly. Although we had not succeeded in finding the eggs of the rhinoceros iguana, we had worked out the



ROADSIDE NEAR ST. MARC

The *Ameiva* lizards were abundant along this road, and at the slightest noise would dash into the thick shrubbery on either side. It was near this point that the *Ameiva* colony was found



ON THE TRAIL TO GOAVIER

The hills of northern Haiti were scoured for lizards. It was found that *Ameiva chrysolæma* had a particular preference for the bottom lands, ascending only a short distance into the hills. Goavier is a small plateau about 4000 feet above sea level



THE LIZARD NEST

The eggs of *Ameiva chrysolæma* were found concealed in the wall at the end of the *Ameiva* burrow. The little lizards, in escaping, would have to dig their way through several inches of packed soil



A LIZARD BURROW

It was found that *Ameiva chrysolæma* digs two kinds of burrows, one for sleeping and another for incubation of the eggs. The latter type shown here was often very extensive, running as much as nine feet into the bank



PREPARING THE EQUIPMENT

The first motion pictures ever made of the rhinoceros iguana in its natural habitat were taken by Mr. Klingel

life history of several other lizards and secured many eggs and adult specimens for investigation in the experimental laboratories of the American Museum. Here the eggs will be reared under controlled conditions, and many observations that were not obtainable in the

field will be studied.

Incidentally we have secured the first motion picture ever made of the rhinoceros iguana, in its natural habitat, and have presented the film to the Museum, where it will be used in the educational work of the Institution.



THE UBIQUITOUS CHAMELEONS, *Anolis*, ARE THE FIRST AND LAST LIZARDS ONE SEES IN HAITI



THE THEORETICAL CONTINENT

How Explorers, Since before the Time of Columbus, Have Been Busy Proving that the Antarctic Continent Is Actually Smaller than It Has Been Thought To Be

BY VILHJALMUR STEFANSSON

THE last region on earth to change from theory to fact lies in the farthest South. Once upon a time we "knew" it was the greatest of continents. A hundred years ago we were beginning to think that there was no continent at all; twenty years ago we felt sure of the main outlines of the continent; and now the solid land is beginning to break up into archipelagos, although it still seems as if there might be enough left to form a decent continent after all.

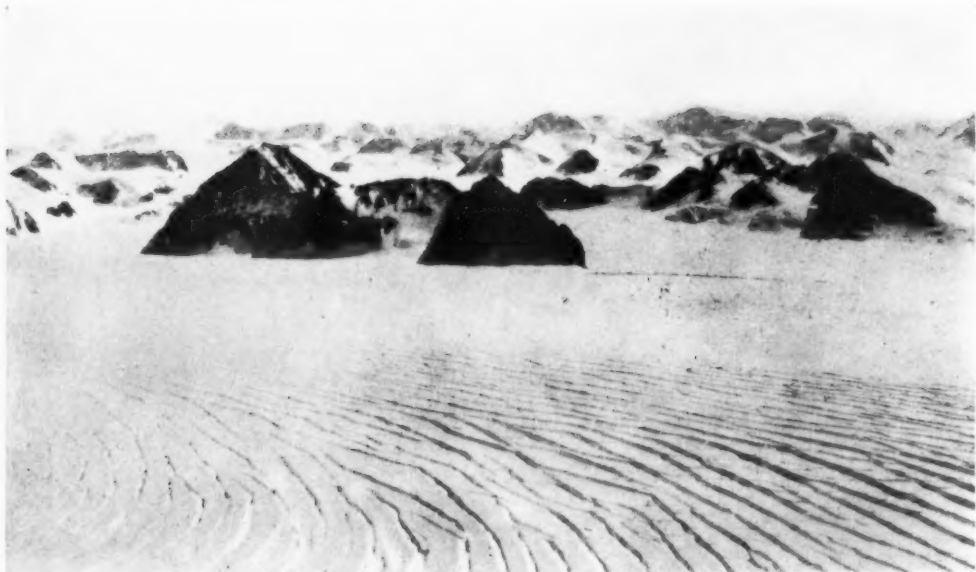
The Greeks were pioneers in southern theories, as in most doctrines which have swayed the intellect of Europe for two thousand years. But within the last two hundred, pioneer travelers from many nations have taken a hand in breaking down the Greek theories and the accretions to them that developed slowly through ancient and mediæval times.

The Greek beliefs about the South started in philosophical doctrines concerning simplicity, balance, and symmetry. Applying their principles, the Greeks viewed the Far North and Far South as

practically identical, differing only in that Europeans could approach or slightly penetrate the borders of the frozen North while they never expected any human testimony with regard to the frozen South.

For, said the Greeks, between us and the frozen South the tropics lie under the sun, forever impassable, with red-hot rocks and boiling oceans. The stories about Egyptians and Phœnicians who had crossed the tropics, if known at all, were considered to be folklore. This view held from around 400 B.C. to 1400 A.D. and was more orthodox in its time than the general doctrines of biological evolution are today.

The earth was spherical to the Greeks and remained so to the learned throughout the Middle Ages. The geographers of every century believed the time would come when someone would sail around the earth from east to west, or would sail to Asia and walk thence overland to Europe. But no one would ever go around the world from north to south, for about the earth's middle was the uncrossable burn-



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AN ANTARCTIC LANDSCAPE

No other land mass in the world is so devoid of life as is the Antarctic Continent. Around its edges birds, seals, and fish are to be found, but in the interior the hardy explorer is rarely heartened even by the sight of a bird on the wing



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SCRIPPS ISLAND

This photograph, taken by Wilkins, is of an island formerly thought to be a part of the Antarctic Continent. Under continued exploration the supposed area of the South Polar land mass has shrunk to only a fraction of the size it was once thought to be



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A WASTE OF ANTARCTIC SNOWS

Time was when much of Europe, Asia, and North America may have appeared in some such guise as this. Now, however, aside from the Antarctic, only Greenland carries an ice cap comparable to that of the Antarctic. This picture was taken from Sir Hubert Wilkins' plane



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WILKINS' PLANE AT ITS BASE

This base was chosen because of its location near a whaling station. In a couple of hours' flying, however, the explorers can be 200 miles or more nearer the pole, over a land where a base could have been established only with great difficulty



Underwood and Underwood



Underwood and Underwood

**THE "ENDURANCE"
DURING THE ANTARCTIC NIGHT**

In this ship, Sir Ernest Shackleton spent the Antarctic winter of 1915 in the ice of Weddell Sea



**THE "ENDURANCE"
GOING DOWN**

Crushed by ice in October, 1915, the "Endurance" sank, leaving the twenty-eight men of the expedition marooned on the ice

*Underwood and Underwood*

SIR ERNEST SHACKLETON SAILS AWAY FOR HELP

After drifting on an ice floe from October, 1915, to April, 1916, the "Endurance" party reached land. From there, Sir Ernest Shackleton and three others, in a whale boat set sail for South Georgia for help. Despite fearful hardships, no lives were lost

ing girdle and at either end were the snow caps, permanently frozen and everlastingly dead. The northern snow cap was supposed to begin not far beyond the north tip of Scotland. Those fringes a traveler might approach, no doubt, and send back descriptions. There would be in the South a similar ice cap, but this could be known only by theory and by analogy from the North.

The public still believes in a northern ice cap, or at least the newspapers still use the term, although it is really a hundred years and even more since geographers knew that there was no northern ice cap and could not be. True enough, snow does cap Greenland. But this does not correspond to Greek theory, for the philosophers believed that the center of the ice cap was at the North Pole. In reality, the center of the Greenland ice cap is more than a thousand miles from

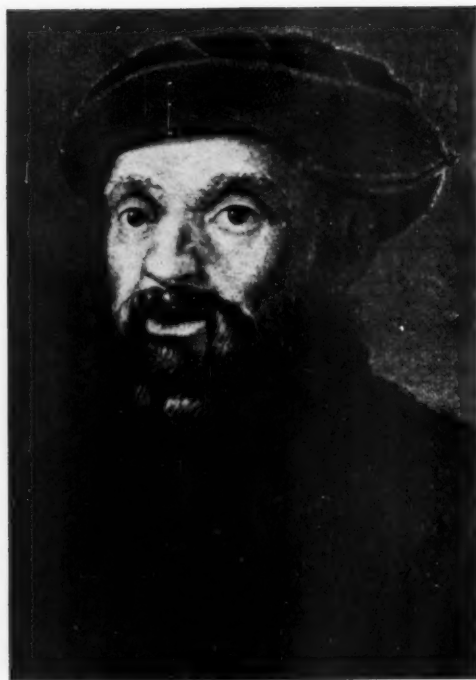
the North Pole, and even its northern tip is 400 miles from the Pole.

The burning tropics were conquered by a group of Portuguese sailors and by a man of genius who directed them, Prince Henry the Navigator. He, or somebody associated with him, developed one of the least precedented ideas that had ever come to Europe, and one of the most liberating that has come to the human mind. The Middle Ages conceived themselves as prisoners between a wall of ice to the north and a wall of flame to the south. Prince Henry was iconoclastic enough to wonder whether there really was an impassable tropic belt. He sent out ship after ship and they went farther and farther, some returning with gruesome tales of the burning death which they had narrowly averted. But they did come back, and so there were others who could be induced to venture, and at times some companies ven-



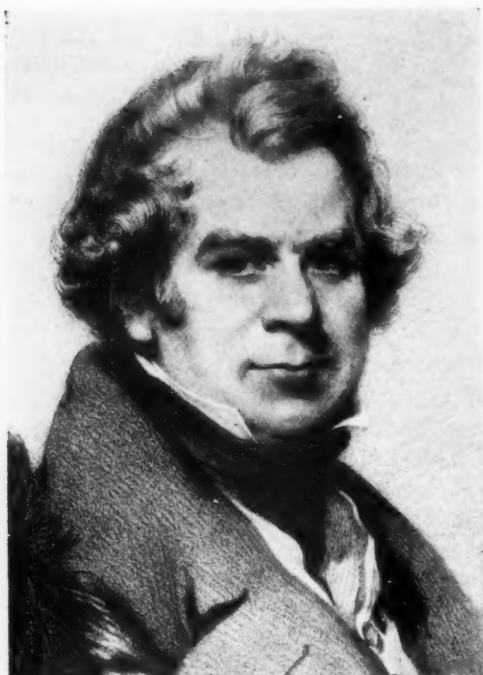
JAMES COOK

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FERNANDO MAGELLAN

Yale U. Press



JAMES ROSS

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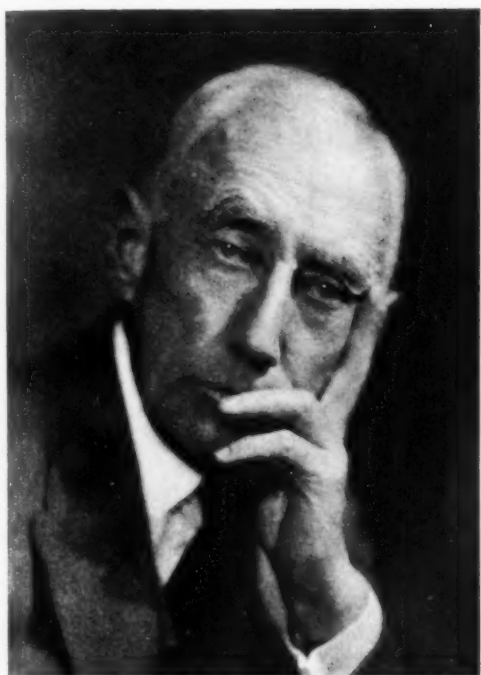


ROBERT F. SCOTT

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FOUR MEN WHO HAVE TAUGHT US ABOUT THE ANTARCTIC

Magellan was the first man to circumnavigate the world, and proved that South America was not attached to the Antarctic land mass. Cook learned that Australia and New Zealand were separate; Ross discovered the Great Barrier, and Scott reached the South Pole only to find that Amundsen had been ahead of him



© Underwood and Underwood
ROALD AMUNDSEN



Underwood and Underwood
SIR ERNEST SHACKLETON



Brown Bros.
RICHARD E. BYRD



Underwood and Underwood
SIR HUBERT WILKINS

FOUR PRESENT-DAY ANTARCTIC EXPLORERS

Amundsen, the first to reach the South Pole; Shackleton, leader of the heroic "Endurance" expedition; Commander Byrd, who is now in the Antarctic; and Sir Hubert Wilkins, whose remarkable flights in 1928-9 lopped still more off the Antarctic Continent. By the time this magazine is published it is likely that Byrd will have actively begun his work of aerial exploration

*Australasian Antarctic Expedition*

DOGS AND SLEDS

By this means polar exploration has laboriously been making headway for generations. The limitations of such methods, however, are obvious, and today dog teams are only incidental aids to explorers

tured again, until finally the sun was straight overhead without burning the ships or cooking the sailors. In fact, they returned with accounts of heat no greater at sea in the tropics than you find on land in Portugal during the midsummer.

This was the final conquest of the burning tropics but only the beginning of European attack upon the great southern continent, Terra Australis.

The Austral Continent, although it looks to us now like pure theory, was very real in the Middle Ages. Africa was a part of it. The first of many powerful blows against it was dealt by the Portuguese, under Dias, when in 1486 or 1487 he rounded the south tip of Africa, amputating a whole continent bigger than North America from the theoretical Land of the South.

The second piece of major surgery was performed by Spain. When South Ameri-

ca was discovered, it seemed to Europe obviously a peninsula running north from Terra Australis. Then came Magellan, Portuguese in blood but Spanish because of his flag, who sailed in 1520 through the strait that bears his name and cut off from the imaginary land a second continent.

Even so, Terra Australis remained the biggest of continents. When New Guinea was discovered, it was thought to be a northward peninsula, and next the land we now call Australia took up a similar rôle. In fact, so sure was Europe that now at last had their eyes rested upon the continent of theory, and so long did they remain assured, that, when the Hollander Tasman in 1642 finally sailed past on the south side, he cut off not only a land mass of continental proportions but also deprived the mythical continent of its ancient name, which hereafter clung to



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MOTOR AND PLANE

Where dogs and sledges could travel ten or a dozen or, with luck, twenty miles in a day, such a plane as this can travel 100 miles an hour, performing in one afternoon the work that dogs would take many weeks to accomplish

the great island which he had lopped off from the theoretical mass, Australia.

Nameless at last, and no bigger than real continents, the former Terra Australis was baptized Antarctica and continued to shrink until finally James Cook, the great navigator of England, sailed around it in an almost circular curve, crossed the mathematical south polar circle for the first time and returned to warn the geographers that, if there was any continent at all, it could not be larger than perhaps twice the size of Europe.

Thus far all discovery had been amputative, or negative. A positive contribution came when the Russians under Bellinghausen discovered the first land ever seen within the Antarctic circle, Peter and Alexander Islands, lying in a southerly direction from South America.

As we have said, many nations contributed to the breakdown of the original

Terra Australis and then to the building up of the more recent Antarctica, but foremost of them is Britain. For after Cook's two great achievements, the first crossing of the Antarctic circle and the first circumnavigation of Antarctica, came in 1831 the first sighting of what is still believed to be Antarctic mainland, and this was by Biscoe, an Englishman.

The great achievement to follow Biscoe was by an Englishman, too, James Ross, nephew of the equally famous John Ross. He was the first to navigate pack ice in Antarctica and first to see the Great Barrier, probably the most startling, or at any rate the least expected sight that ever has greeted human eyes. For nothing in the world differs so strikingly from things we may see in Europe or in other commonplace lands as the sparkling ice cliffs that rise perpendicular from deep water in the sea that has been named after Ross.

*Brown Bros.*

BARRIERS OF THE ANTARCTIC

Where the Arctic is, for the most part, merely an ice-covered sea, the Antarctic is an elevated continent with rugged mountains and high, wind-swept plateaus. The elevation in the Antarctic, therefore, adds still another difficulty for the explorer to overcome, while the mountains themselves form barriers that complicate the problem

We are trying here to show that many nations have furnished explorers, each of whom has been first to do some great thing in the Antarctic. For patriotic reasons and to get one more nation counted, we might like to put Wilkes, the American, ahead of Ross, for his contributions were notable and were earlier. But his Wilkes Land was not the first continental discovery. For a similar reason we have to omit from this particular list the conspicuous French explorer, D'Urville, who found Adélie Land. Later in our own time we shall have to omit similarly one of the great figures of southern exploration, the Australian, Mawson. It is especially trying to have to omit him, for, all things considered, he is probably the greatest of all Antarctic explorers.

In 1894, Borchgrevink, Norwegian by flag and blood, was the first to place a

human foot upon the Antarctic mainland. Five years later, then British because his flag had been changed, he was the first to spend a winter on land in the Antarctic.

But a year before that, in 1898, Gerlache, a Belgian, was the first to winter in the Antarctic pack ice, drifting about held securely between floes, as many ships had been in the Arctic but none before and few since his time in the Antarctic.

In 1902, Scott, British, was first to carry out land exploration on what we now call with a degree of certainty the Antarctic Continent. His farthest was only 380 miles from the base station but was, nevertheless, a remarkable feat, since it opened the way to his own later great work as well as to the expeditions of Shackleton and Amundsen.

Until the discovery in 1928 that Graham Land is an archipelago of islands



Australian Antarctic Expedition

ON THE ANTARCTIC ICE

Across such a surface as this no explorer can travel with ease, and because of the difficulties thus presented, Antarctic exploration has been retarded. Today, however, when dogs and sledges have so largely given way to airplanes, the explorer can accomplish rapidly the tasks that formerly were all but impossible



© Wide World Photos

COMMANDER BYRD'S SHIPS

Tied up to the Ice Barrier near the Byrd Base Camp at "Little America." This Ice Barrier does not mark the shore line of the Antarctic Continent. Instead, the ice is well beyond the shore line, and as it creeps slowly out to sea, it breaks off in gigantic bergs. Hundreds of these bergs are to be found drifting in the Antarctic Ocean, and ships sailing in those waters must be wary of such tremendous floating islands of ice

*Australasian Antarctic Expedition*

PICTURESQUE ICE FORMATIONS OF THE FAR SOUTH

In a whole continent of ice, many strange formations are naturally to be encountered. Ice caverns, precipices, crevasses and hummocks of every size and shape are to be found, with intervening level plains of ice and snow. Furthermore, during the short summers, innumerable icebergs form, and drifting away from this world of ice is a constant procession of ice bergs

and not part of the Antarctic mainland, we had believed that Charcot, the Frenchman, in 1904, was first to see flowering plants on the Antarctic Continent, with his discovery of two such plants on the western coast of Graham Land. But since these are not on the mainland, so far as we know to the present there are no flowers on the southern continent, although there are more than 700 species of them in the northern polar region.

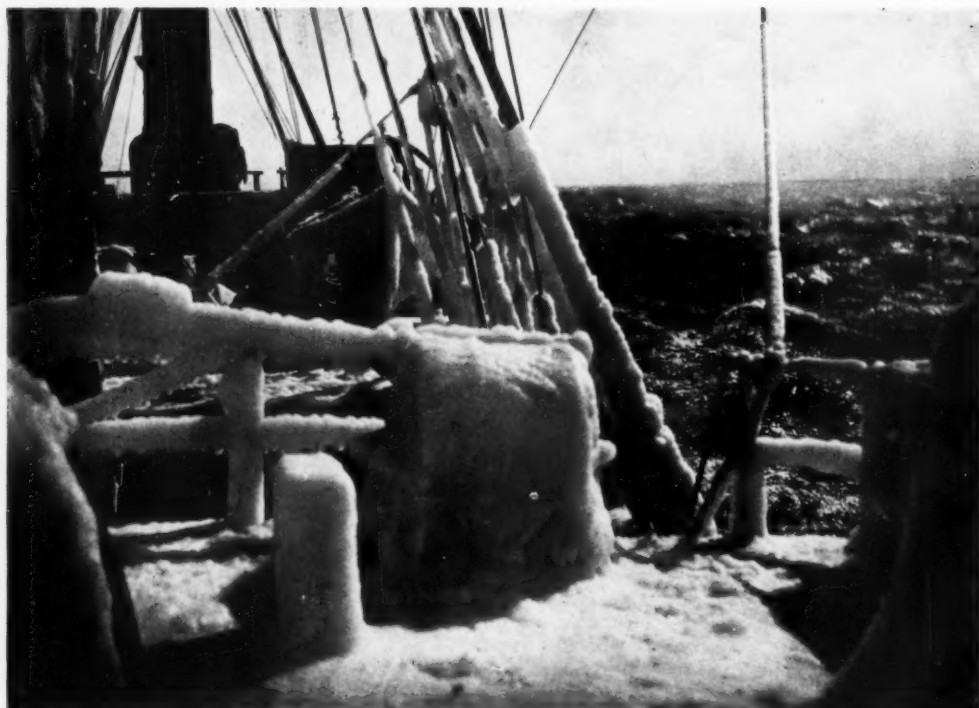
Shackleton had been with Scott's first expedition. In 1908 the British expedition which he himself commanded was first to use motor transport in the Antarctic, first to discover fresh water life in the previously thought to be lifeless Antarctic lakes, and was first to visit the actual locality of the south magnetic pole. In a way, however, the last achievement belongs to Australia rather than England,

for the real commander of the party was Sir Edgeworth David, the distinguished professor of geology from Sydney University.

In 1911 Amundsen, Norwegian, went 97 miles farther than Shackleton had gone and was first to reach the South Pole, December 14.

On November 21, 1928, in the southern hemisphere spring, Wilkins, an Australian commanding a British-American expedition and piloted by an American, Eielson, was first to fly in the Antarctic.

On December 21, 1928, the Antarctic midsummer, he and Eielson made the first discovery flight in the Antarctic, a great air voyage of 1200 miles in which they broke up the previously solid continental map of Graham Land into an archipelago of islands. Crossing what appeared to be the final strait, they flew

*Australasian Antarctic Expedition*

THE FRIGID ANTARCTIC OCEAN

Probably there are few places in the world less given to high winds than the South Pole itself, but about the edges of the Antarctic Continent ferocious and frigid gales are perennial. Down from the icy heights of the continent the cold winds sweep, with the result that ships near the frozen shore sometimes find themselves "iced up" as is the one shown in this photograph

for half a hundred miles or so over gradually rising massive land that is, so far as we know, really continuous with the land on which the South Pole lies and therefore with the land at the far side where Scott, Shackleton, Amundsen, and Mawson have had their base stations and where Byrd now has his winter camp.

The Byrd expedition, although a few weeks only behind Wilkins, did not arrive in the Antarctic early enough for much beyond reconnoitering flights. The geographers had expected both Wilkins and Byrd to find continuous land, parts of one continent. The Wilkins flight disproved these views in the American Quadrant; the Byrd flights, so far as they have gone, have confirmed them in the Australian Quadrant, finding high land and mountain ranges spreading farther away

from the districts which Scott, Shackleton, and Amundsen had shown to be high and mountainous.

The first real season of Byrd's opportunity for air discovery begins around September or October, 1929. With his well equipped and competently directed expedition, he will doubtless add many things to our knowledge and probably give the final answer to the old question of whether there is in the Antarctic a single land mass big enough to be named a continent.

The chance is that this final determination will go to Byrd's credit, for this year he is likely to begin his flying as much ahead of Wilkins as Wilkins was ahead of him last year, for that is the advantage of Byrd's plan. He is spending the winter South, idle so far as flying dis-



Courtesy of the N. Y. Public Library

THE SOUTH POLAR REGIONS AS MAPPED IN 1538

This map, which was drawn in 1538 by Gerhard Mercator, shows what the Antarctic Continent was thought to be forty-six years after Columbus discovered America. Magellan had sailed through the Strait of Magellan, and had shown that South America was detached from the land farther to the south, but Cape Horn had not been discovered and Tierra del Fuego was thought to continue from the Strait of Magellan to and beyond the Pole. Australia and New Zealand were unknown, and the South Polar continent was supposed to be much larger than we now know it to be.

covery is concerned but active in the routine scientific work of the staff. Wilkins has adopted the other method of spending his winters north, going South each southern spring. Before November, 1929, if both programs hold, Byrd will have a month or six weeks of flying to himself, and great things can be done with airplanes nowadays in much less time than that. But if there remain large areas still unknown by the coming November, they are likely to be cleared up through the rest of that month and through December and January by the coöperation of these two competently manned and well directed expeditions.

This possible finality applies only to large-scale or rough preliminary exploration. It would be the real beginning of, let us say, the end of the first chapter of scientific exploration. The second chapter will open in the southern spring of 1929 with a comprehensive national effort on the

part of Australia, under the leadership of the greatest of southern explorers, Mawson, who plans a campaign of many years

with winters spent at home in Adelaide and the summers on the Antarctic shore.

There is a logical progression in the talking points of the three expeditions. The Byrd program discusses chiefly geographic discovery and work in pure science. Wilkins is most concerned with the establishment of meteorological stations that shall in general give certainty to the weather predictions of the whole world and in particular a greater precision to the forecasts of the southern hemisphere. Mawson talks of weather and of pure science, too, but he adds a plan for summer resorts on the Antarctic lands, and for December Midnight Sun cruises that shall be as accessible to Africa, South America, and Australia for their summer as the June Midnight Sun cruises to Spitsbergen and Alaska are to us in the northern hemisphere.



AMUNDSEN DISCOVERS THE SOUTH POLE

This picture is of Oscar Wisting when Amundsen and his party had reached the South Pole in 1911. But where Amundsen and his men made their painful way to and from the Pole on foot and with dog teams, Commander Byrd is shortly to make an effort to fly south by airplane from his base at "Little America" and, if conditions favor him, will be able to make in a few hours the distance that Amundsen covered in 55 days



ANDROS

AN ISLAND OF THE SUMMER SEAS

A Tropical Paradise Fringed with the Largest Barrier Reef of the Western Hemisphere—Its Corals, Sponges, and Fish, Natives, Birds, and Vegetation

By ROY WALDO MINER

Curator, Marine Life, American Museum

ACROSS the Gulf Stream to the eastward of the southern tip of Florida, a score of green tropical islands lie scattered over the summer sea, like stepping stones to the Greater Antilles. These comprise the Bahaman archipelago, together with about seven hundred lesser islets, or cays, and a couple of thousand rocks, just to make navigation perilously interesting.

Though small on the map individually, the Bahamas nevertheless are the outposts and milestones of American history. To one of the least of these, Guanahani, first came European civilization in the person of Columbus. His vessels followed the islands until they led him to Cuba, Porto Rico, and Hispaniola, where he established the first stronghold of Spain in the New World and opened the way to the golden treasures that made the Spanish Main famous. The pirates that preyed upon these rich fleets and on the commerce later established by the British with her colonies, found their hiding places in the multitudinous harbors and waterways of the Bahamas, and tradition fills their caverns with secreted treasure. After the American Revolution, the islands became the refuge of fleeing Tories and their slaves. During our Civil War the Bahamans were made temporarily wealthy through the operations of blockade runners, and in our present day another era of prosperity was assured them by the Eighteenth Amendment to our Constitution.

The islands of the Bahamas are merely the projecting portions of a number of submerged banks of "coral" limestone. In general, they are the raised northern and eastern edges of the banks, the single noteworthy exception being Grand Bahama Island on the southern edge of Little Bahama Bank. Hence, while the eastern and northern shores of the narrow strip-shaped islands rise somewhat abruptly from oceanic depths, they slope gently toward the south and east, almost insensibly passing below sea level to become continuous with the wide stretches of submerged shoals, which are often so shallow as to be navigable only for small boats. About sixteen of these islands are large enough to be inhabited, and all are low and flat, the highest elevation being not more than four hundred feet.

The most important banks are the Little Bahama Bank, the Great Bahama Bank, the Acklin Island, the Great Inagua, and the Caicos Banks, extending in this order from northwest to southeast. The Great Bahama Bank is the largest, lying opposite the Florida Straits and reaching almost to the coast of Cuba. It is shaped like a horseshoe with broad arms, open to the north. The cavity of the horseshoe is formed by the Tongue of the Ocean, an arm of the sea penetrating the Bank, ranging in depth from 700 to 1000 fathoms. The island of New Providence rises above the sea to guard the eastern side of the entrance to this



LOOKING ACROSS THE LAGOON TOWARD ANDROS FROM GOAT CAY

The lagoon inside the Barrier Reef is two miles wide at this point. The Cay is just inside the outer reef. The long line of snowy beach marking the distant Andros shore is clearly visible, as is also the flat character of the island's surface

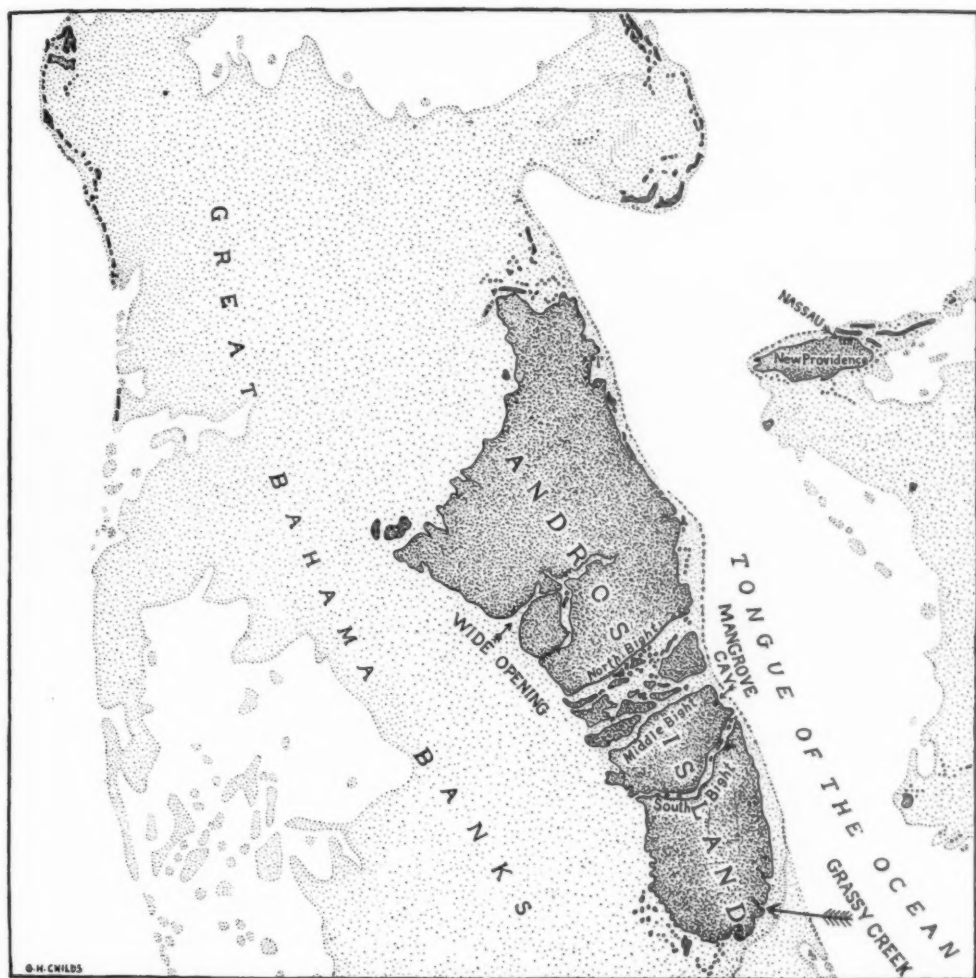
deep *cul de sac*, while Andros forms its western border.

New Providence, by no means the largest of the islands, nevertheless is the most important, for here quaint Nassau is located, the capital and chief port of the Bahamas. The Governor, appointed by the King of England, has his residence here, and along its wharves are the markets to which the chief products of the Out Islands are brought for export, including sponges, sisal, tortoise shell, tropical fruits, and cameo shells. Nassau is also famous as a winter resort, the balmy climate, fine hotels, and picturesque environment attracting many pleasure lovers and those anxious to avoid the severe winters of more northern climes.

The island of Andros is the largest land mass in the Bahamas. It extends for more than one hundred miles in a north-westerly direction, with its northern tip

lying nearly opposite New Providence. Its eastern shore is bordered by a magnificent coral barrier reef, 130 miles in length, almost overhanging the deep waters of the Tongue of the Ocean, and enclosing between its serrated submerged coral forests and the shore a lagoon of relatively quiet waters varying from a half-mile to a mile in width. This lagoon may be entered by channels at intervals and is generally navigable for vessels of light draft.

The island varies in width from twenty to forty miles and slopes gently from its eastern ridge to the western shore where, as in the case of the other islands, it becomes continuous with a submerged western bank, the Great Bahama Bank, extending about sixty miles toward the Florida Straits. This bank is floored with a very fine and soft calcareous ooze and is known by the Bahaman natives



MAP OF ANDROS ISLAND

The Great Bahama Banks to the westward of Andros form one of the chief sponging grounds of the Bahamas. The line of black dots along the eastern shore represents the location of the Andros Barrier Reef

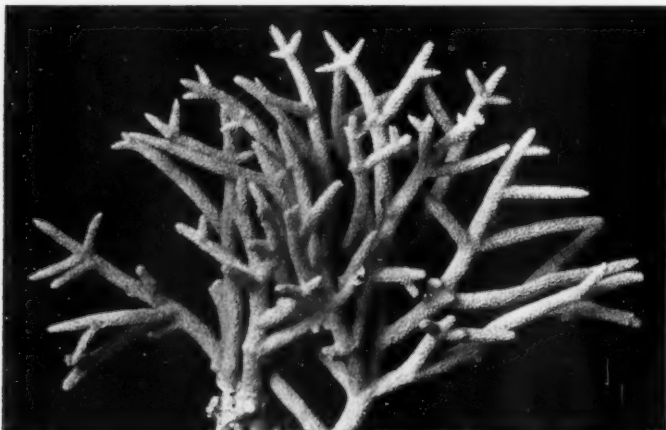
as "The Mud." It is the chief sponging bank in the Bahamas, and together with the banks of the other islands, is the source of the chief product of the archipelago.

The principal varieties of commercial sponge secured here are the velvet sponge, the sheepswool sponge, the yellow sponge, the grass sponge, and the hardhead.

The sponging fleets are organized in Nassau and consist of sloops and schooners, manned by natives, many of whom

are from Andros. [These vessels carry dories nested on their decks. Upon arrival at the sponging grounds, they are anchored, the crews being divided among the dories from which the actual fishing is done.

The spongers use buckets with glass bottoms, through which they can easily see the sea-floor, and thus locate the sponges. They then lower sponge hooks, long poles with two iron hooks at the end, by means of which the sponges are secured and brought to the surface and are loaded on the boats.



THE STAGHORN CORAL
(*Acropora cervicornis*)

In this species, the coral structure grows forward much more rapidly than the polyps reproduce by fission, or self-division, resulting in a loosely branching, tree-like coral skeleton

The commercial sponge is an animal colony of very low organization. The living portion is a black flesh perforated by thousands of pores opening into canals which penetrate every part of the sponge tissue and lead to numerous chambers where the food of the sponge is digested.

Sponges feed upon microscopic animals and plants, such as protozoa, diatoms, and the minute larvæ of larger forms. These are sucked in through the pores and drawn through the canals to the digestive chambers, where a lining of "collared cells" absorbs and assimilates them into the sponge tissues. These collared cells are so called because each is equipped with a tumbler-shaped collar

of transparent tissue from which projects a lashlike whip, or cilium.

The cilia of the thousands of cells lining the cavity beat in unison, and by their rhythmic action keep a current of water passing through the digestive chambers, drawing it through the pores and canals from the outside in the process, thus producing the suction.

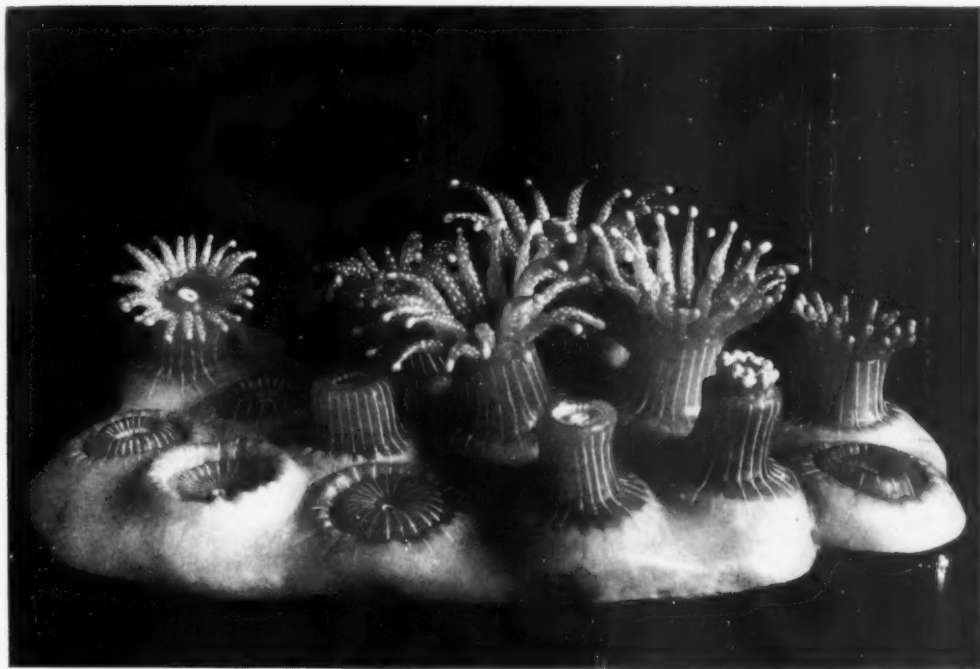
After leaving the ciliated chambers, the water passes through other canals to be emptied into the main excurrent cavities and expelled from the sponge through openings much larger than the incurrent pores, known as oscula.

The living tissues of the commercial sponge are supported by a close network

THE BRAIN CORAL
(*Mæandra viridis*)

This coral receives its name from the convoluted appearance of its surface sculpture, resembling somewhat the convolutions of the human brain. The polyps reproduce by division so rapidly that they divide again before the previous divisions are completed, thus producing long, winding rows of individuals with connected stomach-cavities





TYPICAL CORAL POLYPS HIGHLY MAGNIFIED

These tiny creatures manufacture the great limestone growths composing the living coral reefs. Each is a sac-like animal with an oval mouth-opening at the top, surrounded by a circle of tentacles, armed with sting-cells. They have the power of transforming the dissolved carbonate of lime in the seawater into the solid limestone on which the living polyps are seated in a continuous layer, and which they are perpetually building higher beneath their bodies. The polyps reproduce asexually by self-division, thus rapidly spreading over a considerable area. New colonies are started by sexually reproduced, free-swimming larvæ

of soft, elastic fibers, closely allied to silk in their chemical composition. Their substance is known as spongin, because it is found only in sponges.

In non-commercial sponges, the spongin fibers contain siliceous or calcareous needles of various shapes and sizes, sometimes being so numerous and closely welded that the spongin is reduced to a cementing substance, or, in the "glass" sponges, is lacking entirely. Naturally such sponges are useless for commercial purposes.

When the living sponges have been collected, they are exposed to the sun and air to kill the living tissues, which begin to decay and slough off. In order to hasten this result, the natives repeatedly wash the sponges and beat them

with clubs. They are then brought to a convenient locality on the shore and heaped in partly submerged enclosures, known as "crawls," where they are washed by wave-action. Later the beating process is continued until the soft skeleton is completely freed of animal substance. This is a very disagreeable process, as the decaying tissues naturally are malodorous, to say the least.

After the sponges are thoroughly cured, they are brought to sponge houses, where they are trimmed for market. The vessels then transport them to Nassau, to be spread out under the sheds in the sponge exchange, where they are auctioned to the highest bidder. Later they are further sorted, trimmed, and shipped abroad.

Andros Island is really an archipelago.



A REMARKABLE VISTA THROUGH LUXURIANT CORAL GROWTHS

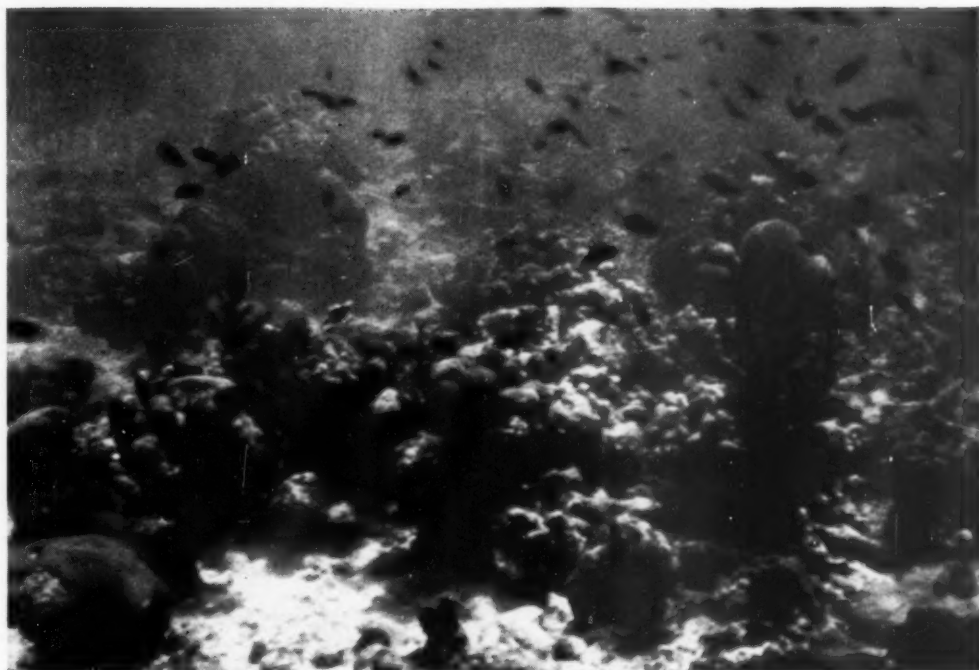
Photographed from the floor of the sea. Tangles and clusters of sea bushes and sea fans rise among the closely crowded heads of various coral species in the clearings between the coral groves

Three straits, known as bights, intersect it from east to west, dividing it into four main portions, of which the northern and southern divisions are the largest. These straits are called North Bight, Middle Bight, and South Bight, respectively, and lead in turn into numerous subsidiary channels winding in labyrinthine fashion among picturesque, low-lying islets, covered with dense growths of tropical vegetation, where it is easy to become completely lost unless one is accompanied by a native pilot. In northern Andros, there is a great inland fresh-water lake approached by a number of these channels, and especially by a channel from the western shore, known as the Wide Opening. Here wild duck, herons, and other birds abound in great profusion, so that the region is a favorite resort for sportsmen. Much of the interior surrounding this lake and its complicated waterways has been little explored, and tradition has

it that it was one of the rendezvous of the buccaneers of former days, and that its forest tangles still hold the secret of buried treasure. Some well-known works of fiction have been founded upon these legends.

Many land-snails of the genus *Cerion* are found on the islets with which the waterways are sown. Their shells are extremely variable in color, sculpture, and proportions, and the animals interbreed in various complicated ways. Since they cannot cross the channels, every cay has its own peculiar varieties and sometimes separate species. For this reason they are quite interesting to naturalists.

Southern Andros is one of the best forested parts of the island. Many hardwood trees grow here to a considerable height, including mahogany, logwood, cedar, madeira, horseflesh, lignum-vitæ, and mastic. Here also there are extensive swamps in the interior. Through



SUNLIT CORALS ON THE BOTTOM OF THE SEA

Among scattered, dome-shaped heads of green brain coral (*Mæandra viridis*) and purple *Siderastraea*, bright yellow nodules of *Porites* completely cover the ocean bottom, gleaming like nuggets of gold in the sunlight

Grassy Creek, so called because of the great stretches of green grass growing over its bottom, there is an approach to an extensive mangrove swamp in the interior, where one of the best-known flamingo swamps is located, made famous by Dr. Frank M. Chapman's investigations and by the flamingo group in the bird gallery of the American Museum, which was one of the results. A quotation from a visitor to this colony gives a vivid picture of the region and its remarkable bird population. "As the boat glides over a wonderful and fantastic growth of sea anemones, coral, and a multitude of fishes, each turn of the creek reveals a new picture of interest. The visitor is greeted all along the shore by cranes, pelicans, cormorants, cuckoos, black parrots, and mocking birds, until at last far across the swamp a wonderful sight, which might be taken for a regi-

ment of scarlet clad soldiers, bursts into view, for here is the breeding place of the flamingo, and hundreds of birds may be seen stalking about in a most stately fashion until they become aware of the arrival of visitors, when, at the signal of one screaming honk, the whole flock rises into the air in a flaming cloud."

Though there are various forested tracts like those above mentioned, a large part of the island is covered with dense tangles of scrub vegetation, largely of a xerophytic character, such as prickly pear and other species of cactus and thorny plants of many kinds. The soil is either limy or black and rich where it occurs, and is rather thin, often giving place to the underlying bare rock.

The foundation rock of Andros, like that of the rest of the Bahamas, and, in fact of the whole southern portion of the peninsula of Florida, is a hardened lime-



A NATIVE CORAL DIVER RESTING AFTER A PLUNGE

A submarine tube and diving helmets were used by the men composing the Museum's expeditions, but partially nude native divers were also utilized to secure corals in shallower waters. This diver has just brought up, by repeated plunges, a boatload of finger corals, *Porites clavaria*

stone partly compacted of wind-blown sand formed from the shells of marine protozoa, and the reduced fragments of the limy skeletons of coral, deposits of calcareous algæ, the shells of mollusks and other marine creatures, and partly of oölitic limestone originating in the soft limy mud or marl such as is found over the sea bottom on the western side of the island. This is considered by many to result from the chemical precipitation of calcium carbonate directly from sea water due to the action of bacteria.

Larger fragments of coral, limy shells, and the spicules of gorgonia also take part in forming the substance of the rock. Frequent rains falling on the rock surfaces and washing through the acids of

the decaying vegetable soil dissolve the alkaline rocks so that they become at first pitted and then porous with cavities that unite beneath the surface to form a rock looking like magnified and hardened sponge. Near the shore, the superficial portion of the rock becomes eroded away by wave action so that the underlying cavities are unroofed, leaving sharp irregular pinnacles that make walking difficult. In many places, these smaller cavities have become enlarged to form subterranean passages and caverns.

Here and there, circular pits resembling potholes have formed, several feet in diameter, which penetrate the depths and have subterranean connections with the sea, either at its present or its former levels. These pits are often called "banana holes" by the natives, because they are occasionally filled with black and fertile earth, washed into them by rains, in which clumps of bananas are readily cultivated.

In wild places, tangles of tropical vegetation grow in them most luxuriantly. Many of the connecting caverns are said to have been utilized by pirates.

Andros was doubtless much more elevated than at present, and there are indications that partial submergence has taken place at a comparatively recent date. Out in the lagoon inside the coral reef there are submerged pits, similar to the terrestrial pits, and called by the natives "blue holes," because the deep water in them appears bluer than the surrounding shallow water of the lagoon. These are more or less circular wells often many yards in diameter extending down to considerable depths and lined with coral growths. Usually there is a

submarine connection with other "holes" and often with the open sea outside the reef. Gibson Cay, which is an islet a short distance inside the outer reef, has two land-locked blue holes, like circular ponds in the midst of the low, porous rock of which the cay is composed. Each of these is alive with large marine fishes, which could enter only by a submarine passage. Each of these blue holes has a corresponding submerged blue hole in the shallow water outside the cay and close to the summit of one of the reefs.

When the tide is flowing, it is sucked into the outer holes, and rises in the land-locked pools on the cay. When it is ebbing, the water-level sinks in the inner pools, and rises boiling out of the submerged holes outside. These blue holes were doubtless formed by rain erosion and solution when they were elevated above sea level, and have been enlarged

by wave and current action, and perhaps by the grinding of loose coral heads since they were submerged. At this time, of course, they received their lining of living coral growths.

The coral reef of Andros, which borders its eastern shore, has been described in a previous issue of *NATURAL HISTORY*.¹ Exposed as it is to the trade winds blowing steadily against it from the east, and the upwelling currents from the depths of the Tongue of the Ocean, plenty of microscopic animals and plants are washed within the reach of the millions of tiny tentacles surrounding the hungry mouths of the polyps which crowd the coral growths. The dashing waves are loaded with oxygen and all the conditions are favorable for the growth and propagation of the forms associated in the life

¹"Hunting Corals in the Bahamas," By Roy W. Miner, *NATURAL HISTORY*, Sept.-Oct. 1924.



THE ANDROS BARRIER REEF FROM THE SEA FLOOR

The elkhorn coral (*Acropora palmata*) rises like huge marble trees with interlacing branches, tinted with saffron and terminating in broad, palm-shaped fronds. Extensive groves of these corals dominate the Barrier Reef, which parallels the eastern shore of Andros for 130 miles



THE ERODED ROCKY SHORE ON THE OUTSIDE OF LITTLE GOLDING CAY

This islet is on the line of the outer reef, and its windward shore is exposed to the surf driven upon it by the trade winds. The attacks of the waves break down the roofs of the miniature caverns with which the rock is completely permeated, and leave behind sharp eroded pinnacles standing so close together that the rock is difficult to walk upon

of the reef. Hence its development is unusually prolific.

The coral polyp is not much more than a sac-like stomach with a mouth surrounded by tentacles. The tentacles are furnished with sting-cells which kill or stupefy the minute prey, which is then drawn into the stomach and digested.

The polyp has the power of precipitating the calcium carbonate dissolved in sea water so abundantly in the tropics, and of laying it down beneath and around its body to form a cuplike skeleton or calyx. This is continually built higher, the polyp always being perched on the top. As the polyp feeds, it grows, and, after reaching a certain size, starts to divide into two polyps, the growing skeleton dividing with it. This process is repeated again and again with the result that huge limestone structures are formed with myriads of polyps over their surface.

If the upward growth is more rapid than the division, a tree-like coral skeleton is formed. If the division of the polyps keeps pace with the upward growth, a massive or dome-shaped coral head results. The staghorn coral (*Acropora cervicornis*) is an example of the former method of growth, and the star coral (*Siderastræa radians*) of the latter. The brain coral (*Mæandra viridis*) is a species in which the division is so rapid that before a polyp is completely divided the two halves divide again. New colonies are started by means of free-swimming larvæ, hatched from fertilized eggs.

Millions upon millions of polyps, each building a limestone castle, and continually increasing in geometrical ratio by self-division, in the course of time erect enormous and extensive reefs, the number of individual coral growths being spread and multiplied by the sexually formed free-swimming larvæ. These

reefs, in turn, are shattered by storms, the fragments being heaped up and consolidated until their substance is added to previous accumulations upon the shallow bank forming their substratum. When these heaps are raised above the level of the sea, the fragments are further broken up and amalgamated with drifting or windblown sand, while chemically precipitated calcareous mud from the warm and shallow waters of the protected lagoon infiltrates the crevices and becomes a part of the whole. The shells of mollusks and other marine creatures contribute their quota as do the calcareous plants. An islet is thus formed subjected to weathering and wave erosion. Soil and seeds, including coconuts, are washed upon its shores, tropical vegetation springs up and various forms of animal life come to dwell upon it, and

finally perhaps man. Thus our coral polyps qualify as world builders.

The dominant corals of the Andros barrier reef are the great palmate, or elkhorn corals (*Acropora palmata*), which grow up from the submerged platform as groves of gnarled and twisted limestone trees, towering to a height of ten or twenty feet, with closely interlaced branches, tan in color, with snowy white tips, the longest of which always grow away from the prevailing winds and currents and thus point toward the land. The ends of these branches tend to reach the surface at low water, while those that grow toward the open sea are more stunted, so that as one views the barrier reef from the surface, the tips of the corals all seem to point in the same direction.

The elkhorn coral groves are often triangular in shape, with the apex



A WEIRD LANDSCAPE ON GIBSON CAY

Illustrating the eroded and cavernous character of the limestone rock composing many of these islands. The view is taken not far from the border of one of the land-locked "blue holes" described in the text. Underneath the surface of the rock, complicated miniature caverns and passageways give it the appearance of a huge stony sponge



A SAIL CONSTRUCTED FROM FLOUR SACKS

The native boats are usually homemade, and are often crude affairs, but they form the only effective means by which the negroes can get about from island to island or secure the large proportion of their food that comes from the sea. The dusky crew of this craft manipulates it with amazing skill

pointed toward the open sea, and with reëntrant angles between them. At one place twelve of these huge groves were counted adjoining each other within the space of three-quarters of a mile, making a zigzag outline, like the teeth of an enormous saw.

In front of these groves, as we viewed them from the sea-bottom through the windows of the Williamson submarine tube, we could see close-set thickets of staghorn coral, their tapering branches bristling in all directions, interspersed with frequent clumps of the closely related *Acropora prolifera*, the delicate tracery of its finer branches forming symmetrical fan-shaped clusters that seemed too fragile to withstand the currents of their exposed position, while here and there loomed the domes of brain corals and purple *Siderastræas*. In the reëntrant angles between adjacent groves,

groups of short columnar growths, with rounded tops or mushroom-like caps were visible. These were the orb corals (*Orbicella annularis*), their green and pink tops adding touches of soft color to the scene. Here the sea floor was heaped with nodules of golden yellow *Porites astræoides*, resembling nuggets of gold as the flickering light of the sunbeams penetrating the ocean surface played over them. Hosts of purple and yellow sea fans waved back and forth in unison. Magenta sea plumes, brown sea bushes, and purple sea whips diversified the scene with their soft plantlike colonies. Scarlet sea anemones, gray, red and green sponges, the spirally unfolding gill-circlelets of the *Spirographis* worms, with their purple and gray filaments, like pulsating passion flowers of the sea, enlivened with their bright colors the softer hues of the corals. Above, around and

through the coral branches darted schools of brilliantly colored fishes, their striking, iridescent patterns flashing like jewels in the sunlight which streamed down upon them.

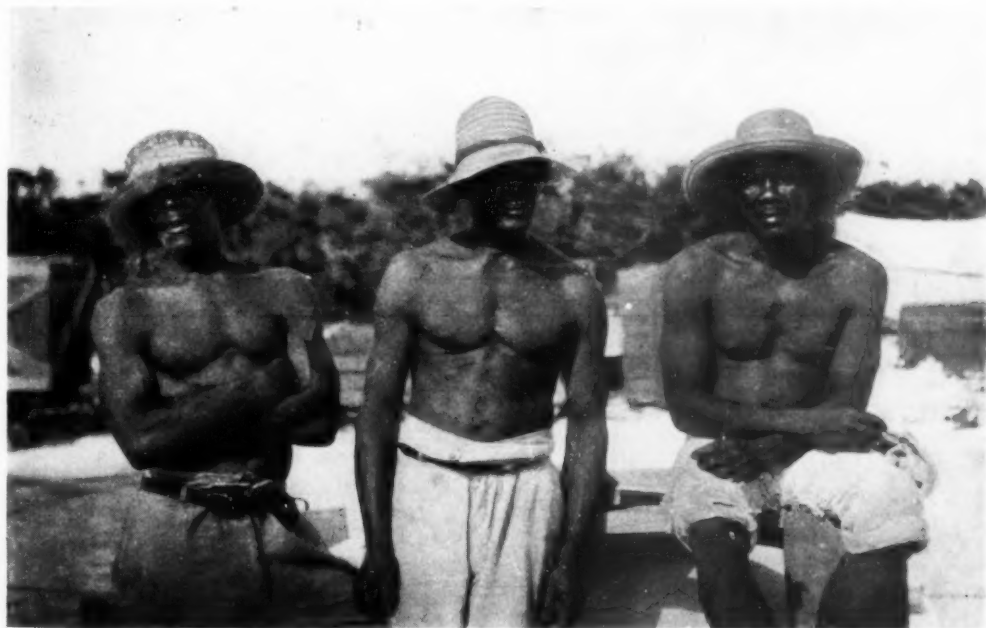
The onlooker, gazing at this scene from the ocean floor, seems to be transported into a new world of strange and weird beauty, a world of tinted marble forests, where interlacing fronds intercept the dancing sunbeams penetrating the watery atmosphere, clear as crystal in the foreground, but melting into a soft powdery blue haze here and there shot with flickering gold where the sunlight illumines it; a world in which deep but colorful shadows alternate with motile areas of contrasting brilliancy, punctuated by the kaleidoscopic swarms of gleaming and darting fish forms. Humanity, with its troubles and complexes, seems far away and of no importance. However, after a time, we remount the tube, come out

once more above the surface of the waters, and turn our faces toward the land.

It is very interesting to a person from northern lands to approach such an island as Andros from the open sea. The shore lies so low that the first glimpse of land reveals only a long line of bay spikes, irregularly spaced like the broken teeth of a fine comb, appearing and disappearing momentarily among the dancing waves on the horizon. Soon these resolve themselves into distant palm trees, which rapidly become larger and more plainly visible as the boat nears the shore.

Now it is possible to see the waves breaking against the exposed tips of the coral barrier in long lines of white foam which contrast vividly with the ultramarine blue of the open sea and the brilliant green slicks of quieter water covering the sand bars within the lagoon.

As one enters the channel, above the settlement of Mangrove Cay, the shore



THREE TYPICAL NATIVES OF ANDROS

These brawny men were used as divers during one of the Museum's expeditions. The original inhabitants of the Bahamas were Carib Indians. They were early exterminated by the Spanish settlers, and the islands were later repopled by negro slaves brought from Africa. There are now about 7000 negroes on the island of Andros



CLIMBING FOR A DRINK

Groves of coconut palms grow luxuriantly along the shore of Andros. The meat or "jelly" lining the interior of the nut is most nutritious, and, when picked at the right time, the central cavity is filled with a cool and most refreshing fluid, the coconut "milk"

still seems far away across the two miles of lagoon, but when closer, the band of snowy beach becomes visible with the plumes of the coconuts tossing above it, overhanging thickets of sea grapes and clumps of bay lavender, while, here and there, the dense glossy foliage of almond trees relieves the monotony of the coconuts.

Beyond rises a low ridge partly bare and partly clothed in verdure, dotted with the huts of native settlements, while on the crest of the hill the red roof of the more pretentious Residency of the Commissioner is visible. Toward the south, a cluster of stone houses surrounded by a wall, with the Union Jack

floating over it, proclaims the location of the Government Offices. Soon we are anchored off a little wooden pier extending far out into the water, but as it is now low tide, it is too shallow for our boat, and we are obliged to land in a dinghy. A shout from the shore attracts our attention, and presently a tall, thin, white man comes running out on the pier, followed by a straggling line of negroes of assorted ages. We are soon shaking hands with Commissioner Forsythe who greets us most cordially and offers us the hospitality of his home.

Andros was originally inhabited by Carib Indians like the rest of the Bahamas, or the Lucayos, as they were called by Columbus. The Spanish conquerors enslaved the entire population of the archipelago, numbering about 40,000, and transported it to Hispaniola, where it was soon exterminated. Now the only traces of the aborigines consist of skulls and other bones found in some of the

caves of southern Andros, where also remains of a canoe with paddles were discovered. The present population consists of about 7000 negroes, the descendants of slaves brought from Africa. The only whites are the Commissioners of Northern and Southern Andros, and their families, and a few missionaries. Commissioner Forsythe, of Southern Andros, acts as the representative of the Governor at Nassau and rules over his negro wards with a firm but kind hand. He is also Justice of the Peace, and, as such, holds court and sentences offenders. The jail is in the walled compound with the executive offices. When I visited the building, there was one prisoner there.

He was sitting on his cot in a most comfortable cell with the outer door wide open and the sunlight streaming in. He seemed quite happy. I asked him what he was put in there for, and he said he didn't know. He said he went out whenever he pleased during the day, but was always on hand for meals. In the evening he came back promptly in time for dinner, and was locked up for the night. He said he thought he was well treated.

Of course, the Commissioner performs the marriages for his black subjects. When asked how he could arrange it for so many, he said he married all he could and the rest "just got along."

Among other duties the Commissioner is Warden of the Flamingoes, and makes periodical visits to the colony at Grassy Creek, endeavoring to enforce the gov-

ernmental protection over the practically defenseless birds. Otherwise natives would exterminate them.

Most of the able-bodied men of Andros engage in sponging, and are away with the fleets a large part of the time. Agriculture suffers in consequence, though the island is capable of growing tropical fruits. Plantations of these linger here and there and are carried on in a desultory sort of way. The negroes are happy-go-lucky and support themselves on what they earn sponging, or living on coconuts, fruit, and by fishing. There are plenty of fine food fishes in the lagoons and around the reef. Bone-fishes, barracudas, red snappers, trunk fishes, jacks, green turtles, spiny lobsters, and conchs abound and may be secured with little effort. Iguanas live in the interior and are so much prized



PICTURESQUE CLUMPS OF BAY LAVENDER ADORN THE UPPER REACHES OF THE OCEAN BEACH

This decorative plant (*Suriana maritima*) has a gray-green foliage and gives the impression of having been sprinkled with a white, powdery dust. Great mound-shaped clusters grow on every sandy beach and add much to the beauty and diversity of the shore vegetation. The burrow-openings of land crabs are often overshadowed by their leafage

for food that they are now becoming scarce.

"Diving conchs" is a favorite occupation. Natives often may be seen with their boats anchored in the lagoon, engaged in diving down into the clear waters for these huge sea-snails of which they are very fond. The flesh though edible, is quite tough. It is often cut up and eaten raw. It also forms an excellent bait for fishing.

One of the methods of catching the sea turtles is interesting. When one of these huge creatures is seen rising toward the surface, a native will suddenly dive from his boat and seize it firmly by the front edge of the shell just above the turtle's head. The creature will immediately dive, and the negro, holding his breath, will cling for dear life and manage to get his feet on the hinder part of the shell, so that he can throw his weight backward, and thus turn the turtle's head toward the surface. This causes the turtle to swim upward. When the head of the negro breaks through the waves, he takes a quick breath. The turtle turns and dives downward again, and the process is repeated until the turtle is

tired out, and can no longer dive. He is then hit over the head with a hatchet, killed, and hauled aboard the skiff.

The native boat is usually homemade and is a very crude affair, with sails constructed of odds and ends. I have occasionally seen the latter made of four old flour sacks sewn together. The negroes are expert sailors and can keep tiny boats upright in a stiff wind with a large spread of sail, while the same boat will immediately capsize in the hands of a white man.

They are a simple but very kindly people, living in a region of perpetual summer, and lead happy lives as a rule. At times, however, devastating hurricanes descend upon them, swamping sponge fleets, drowning crews, destroying houses and crops, and blowing down the precious coconut palms. The poor natives then suffer every hardship. But the Colonial Government steps in with food, clothing, and medicines, and through the agency of the Commissioner, alleviates their sufferings. Huts are rebuilt, more crops are planted, crude boats are pieced together, and soon the troubles are forgotten. Andros once more resumes the aspect of a tropical island Paradise.



NOSES

How Nature Adapts and Develops Noses to the Needs of
Her Creatures—Queer Uses for Queer Noses

By ROBERT T. HATT

Assistant Curator, Mammals of the World, American Museum

SMELL and taste are but slightly differentiated branches of one sense.

Violets and vinegar produce sensations of smell and taste that are quite similar, and thus we are given an opportunity to take more delicate samples of many objects by smelling than by tasting. Taste is the chemical informer to the brain, located in the mouth, which acts as messenger concerning whether or not things introduced there may suitably be swallowed. In both the water-living vertebrates and land

mammals the sense of smell samples the air or liquid environments, and gives the brain information of what lies about that the eye may not see nor the ears perceive.

In this same way the housewife usually selects melons by odor, and a careful cook will not use an egg until the nose has verified the diagnosis of the eyes. Unfortunately

some things, such as salt, produce no volatile odor, and must be dissolved to give their information.

In many lower animals, amphibians, reptiles, and marsupial mammals, there is a passage between the nasal chamber and the roof of the mouth, the function of which, in the lower animals, may be

the sampling by smell of things that have been taken into the mouth.

Our delicate odor receptive cells lie within a moist chamber, and, as in the fishes, all stimuli must be borne to them first through a liquid medium. In most fishes the olfactory nerves ramify over a rosetted membrane lining a small pit on the under side of the rostrum. As fish are not lung breathers, they have no occasion to pass the air or water on to the pharynx, as we have. Their noses are but

pockets to guard these most important sense perceivers.

It is likely that this chemical-receptor sense is the earliest of all developed, or at least concurrent with the sense of touch. Give a baby a new object. What does he do with it? Usually he carries it directly to his mouth. Thus he gets his first information about things.

What's in a nose? In truth the interior of the nose is equipped to perform two vastly important functions other than smell. Firstly, it must remove all impurities from the air and kill the harmful bacteria before they reach the lower respiratory passages. Secondly, it must warm the usually cooler air to body temperature.



"Mrs. Murphy" is submersible and has her nose where it alone can be out of water



GORILLAS HAVE LOW NOSES

Note the great contrast between the nose of the gorilla above and that of the proboscis monkey on page 499. The first foreshadows the nose of man, while the other is probably only for display

For this there is an elaborate and beautifully delicate set of turbinate bones that are covered with a richly vascular membrane. Through the small channels in these bones the air must pass and in the process it is quickly warmed. The all but extinct sea otter which lives in the cold waters of the North Pacific is the best equipped of all the mammals in this regard. When one looks into the nasal chamber of a sea otter's skull, he sees a set of these turbinates that have the complexity of a sponge.

One might expect to find in whales the best set of turbinates, but strangely enough they have none at all! This is somewhat compensated for in the sperm whale by a set of air chambers which doubtless aid in warming up the air.

These scroll-like turbinates vary considerably in their complexity in different kinds of animals. There are in the main,

two pairs of them, the ethmo-turbinals, which grow out from a median bony septum in the nose, and the maxillo-turbinals, which grow inward from the upper jaw. The olfactory nerves are said to be distributed largely over the first set, while the lower set are chiefly concerned with air warming. Thus cats, whose sense of smell is poor, have small ethmo-turbinals, while dogs such as bloodhounds have them well developed. It will be noted that the breeds of dogs whose sense of smell is best developed have deep muzzles, accommodating large ethmo-turbinals, while dogs that hunt by sight, such as the borzoi, are very shallow here.

The better to detect a subtle odor we breathe deeply, or, in doglike fashion, sniff the air, thus sending a better draught into the olfactory chamber.

The keenness of scent among other

animals is a thing that human beings can scarcely appreciate. Hounds, dogs which have been developed for ability to detect and follow the faintest odors, are probably among the best equipped of all. A good dog may be put on a rabbit track and, by examining its odors over but a few feet of the trail, will know which way the animal traveled. He can also, of course, distinguish between many kinds of animal trails. A good coon dog will not follow a possum or a rabbit trail. The mysteries which a dog can unravel by nosing his signal stations, we can but speculate on.

The keen scent of both dogs and pigs has been utilized in France in the hunting of truffles. The dogs used for this are usually poodles, white by preference, as they are used at night. These dogs are trained to dig up the truffles and carry them to their masters. In Anjou and in America the squirrels dig up foul-smelling false-truffles of several species and use them as food.

Squirrels have often been supposed to find their myriad buried nuts by scent, yet squirrels consistently failed to find



Photograph by Herbert Lang

FACIAL ADORNMENT IN AFRICA

The sense of smell is highly developed in savage peoples because of the thousand and one ways in which they are daily dependent on this sense for survival in their primitive environment. Under similar conditions the white man's sense of smell would probably again become as keen as theirs

nuts which were covered by but a very thin film of sand in a tray from which they were fed every day. These squirrels would, on the other hand, find at least some of the nuts which they themselves had buried. Memory doubtless plays an important rôle in the location of their stores.

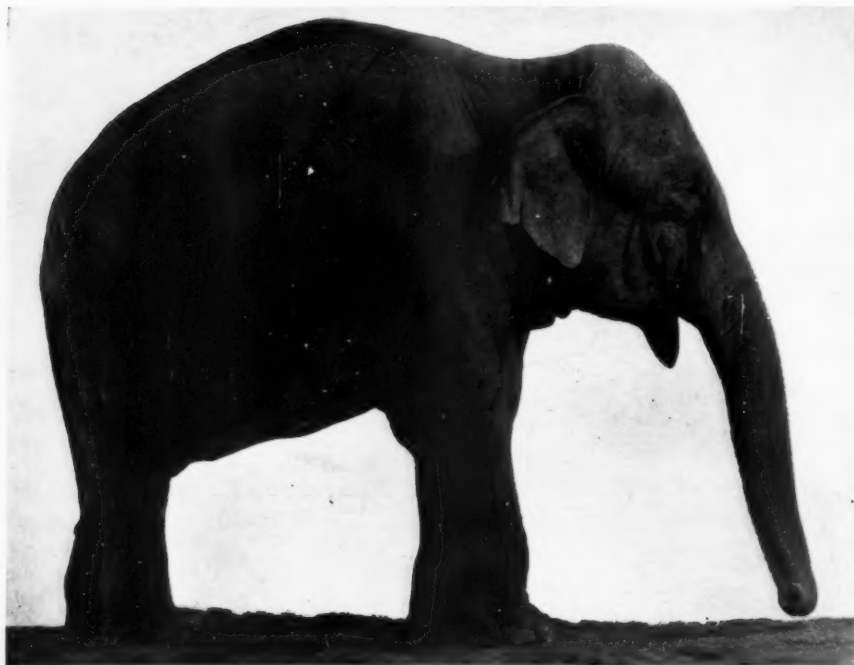
There are numerous instances in which scent has apparently led animals to swim great distances in search of food. Red squirrels often are seen swimming Lake George, it is said toward the chestnut crop on the other side, but scent may or may not be the agency that induces the adventure. I have been told of wild pigs which swam several miles through salt water to an island on which coconuts were ripening, and in this instance the wind was from the island to the mainland. I have traced a skunk two miles upwind, and I have detected a whaling station at a much greater distance, but our noses are of little service to us in connection with less spectacular phenomena.



Photograph by Le Gros Clark

A PROBOSCIS MONKEY

This gaudy, leaf-eating monkey of Asia is notorious for his pendulous nose and tremendous stomach



NATURE'S BEST NOSE

A gatherer, bath spray, weapon, and bugle all in one, the elephant's trunk is his priceless possession

Noses take many shapes. Among men they are to a high degree diagnostic of races, and through this, to some extent are guides to character. The straight

and narrow nose of the Nordic and the low broad nose of the Negro are contrasting features of races whose psychic traits are in bold contrast. Among other primates the gorilla and the proboscis monkey offer the greatest contrast in development, though not in underlying structure. The nose of the gorilla foreshadows the nose of man, while the nose of the proboscis monkey (developed strikingly in the old males only) is probably but a feature for display.

Many peoples, feeling that nature could be improved upon, have decorated their noses with tattooing and painting. Among the European races, it is not uncommon among the fairer half of the population to restore the lost lanugo, or "bloom of youth" with finely powdered rice. Certain South-Sea Islanders and some African tribes pierce the septum of the nose and here introduce such glorious jewelry as shafts of ivory, bone, or wood. Re-



THE SEA OTTER'S NOSE

The sea otter has an elaborate air-warming sponge-like structure in his nose

cently our pugulists and actresses who, through accident or inheritance, had noses unpleasing to them, have had their profiles altered the better to suit their tastes.

Externally our noses have little function other than protecting their two openings, the nares, and guarding the eyes. Size alone means little. Early in the Eighteenth Century there lived in Yorkshire a man named Thomas Wedders whose nose had the unequalled length of seven and one half inches, yet the only benefit which he derived from this remarkable feature was a meager livelihood by exhibiting it. But, as we shall see, to many other species of mammals the form is most important.

The nasal region of the head (everything in front of the eyes) has been hypertrophied in numerous creatures for different purposes. The elephant's trunk compensates for his unparalleled combina-

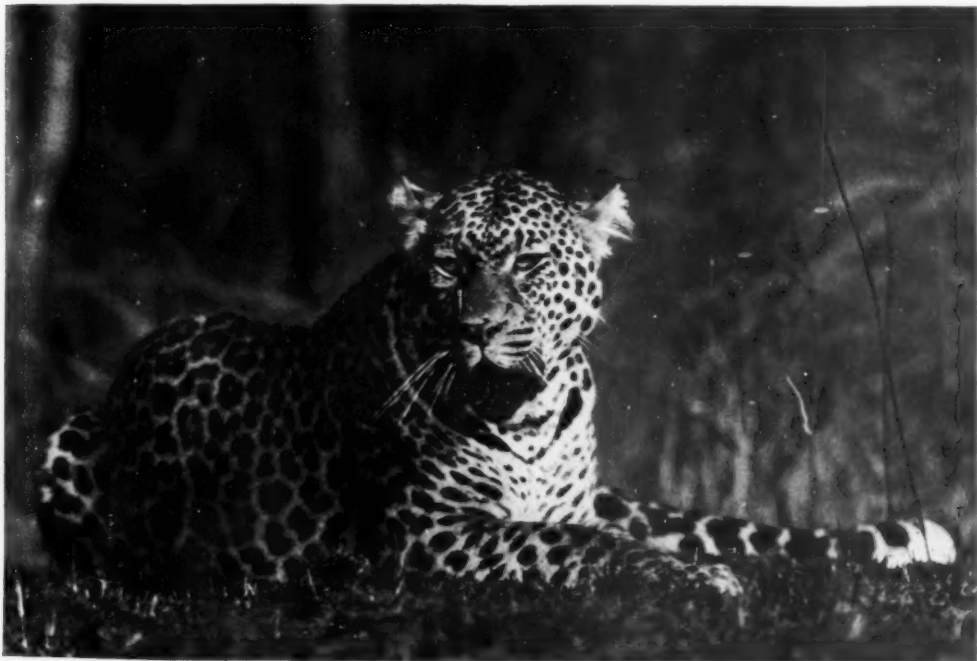


Photograph by Donald B. MacMillan

THE NOSE EQUIPMENT OF THE WALRUS

Whiskers like a steel brush on the walrus' broad muzzle are supposed to aid him in finding mollusks buried in the mud

tion of great stature and short neck. Thus he can feed from the ground and drink



Photograph by Jenness Richardson

A CAT'S NOSE-GUARD

Members of the cat family and their old acquaintances, the mice, carry long whiskers on their noses to help them feel their way in the darkness



Photograph by C. H. Townsend

MUSIC HATH CHARMS

A male sea elephant inflates his cavernous proboscis to trumpet his message to the beach colony

without bending his knees. With this mighty nose he can pull down trees, shower himself with water or dust, feel the air in all directions without moving his great bulk, and trumpet to his heart's content. In short, it is his priceless treasure and he guards it as such. But we know that it took the elephant a long time to get this and the "crocodile of the great-green-greasy Limpopo river" had nothing to do with it.

The tapirs have developed along the lines of the elephants, but as their noses are shorter, these lack the versatility of the trunks which they slightly resemble.

The giant anteater has developed a long tube in front of his eyes, too, but this is more than a trunk. The skull itself is

elongated almost to the tip, and the head acts more as a scabbard for the long exploratory tongue, than as a face of any other legitimate excuse. In all this long mouth there are no teeth, for his mymecophagous diet does not require them. One famous French anatomist found that even in the case of dogs, those whose teeth were pulled at an early age developed larger skulls than did their litter mates.

The sperm whale has a great square nose that houses a reservoir of spermaceti oil, which in all likelihood is there as a buoyant mass to aid in control of the over-



From a Model by G. R. Miller, Jr.

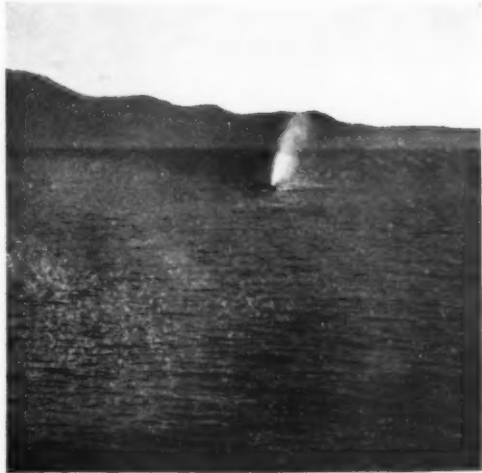
THE LEAF-NOSE

The exuberant nasal exfoliation of this insect-eating bat carries a special set of sense organs essential to its insect-catching habits

heavy head. From this nose emerges but a single nostril, and from this nostril rushes out the warm air from his lungs, heavily laden with a water vapor that condenses as it strikes the cold air and forms a great shower of spray. It is this sight that moves the man in the crow's nest of a whaler to cry out "Thar she blows," with which cry the chase begins.

The male sea elephants have a large sinusoidal proboscis which they inflate and with which they trumpet. So far as we know, it has no other use.

Pigs, coati-mundis, aard-varks, and others, whose calling is to root up the earth, have strong, long snouts and the



Photograph by R. C. Andrews

(Right)

USELESS NOSES

The borzois with heads high above the ground have shallow nasal chambers and a poor sense of smell, for they hunt by sight



Pamela and Parma O'Valley Farm

(Above)

"THAR SHE BLOWS"

A finback whale empties his lungs within sight of a whaler. The fountain is formed of the condensed vapor as it strikes the cold air

(Below)

AN EARTHLY
DOUBLE STAR

Twenty-two fleshy feelers halo the nose of the star-nosed mole



Photograph by M. C. Dickerson

will to use them. A pair of wild pigs in the New York Zoo ripped up the entire asphalt floor of their outdoor enclosure, and under this probably found nothing to justify their labors.

Some noses are seemingly made as living probes. Australia's spiny ant-eater, the moles and many other insectivores, have noses with which they probe loose earth and insect burrows in quest of their elusive delicacies.

The *ne plus ultra* of all probes is borne by the star-nosed mole of the United States. This animal's most forward point is encircled with twenty-two fleshy probes which give him great advantage over



Courtesy N. Y. Zool. Soc.

ASPHALT PLOWS

These hogs have done with their noses that for which we would use pneumatic drills. To help them there is a plate of bone within the nose pad

kindred burrowers that search the soil for worms.

When in search of sensitive noses, though, we find their optimum not in the earth-heaving insectivora, but among our finest fliers, the bats. Large numbers of species of the leaf-nosed bats have elaborate yet delicate foldings of naked skin about their noses, and these structures are equipped with delicate nerve endings which are believed to pick up vibrations in the air caused by insect wings or by the echo of air waves initiated by the bats themselves. Their night-marelike physiognomies are scarcely excelled in grotesque features by the ceremonial masques of primitive men. Only one group of the fruit-eating bats even approaches the elaborate facial make-up of its carnivorous allies, and this is the tube-nosed bats of Malay. The nostrils

in these forms open out from long fleshy tubes whose function may be the furnishing of an outlet for air when their muzzles are buried in a large fruit.

There are in several desert-living animals—animals whose noses are frequently subjected to the unpleasant blasts of sand and dust—sphincter muscles about the nostrils which close these when the need arises. Similar constriction occurs in such aquatic animals as the beaver and the hippopotamus.

Position of the nostril means everything to aquatic air breathers. Hippopotami, crocodiles, frogs, whales,—all have their nostrils so located that these parts emerge first from the water—and too, that the animals may lie hidden except for their nostrils and their eyes, which project up above the general level of their heads.

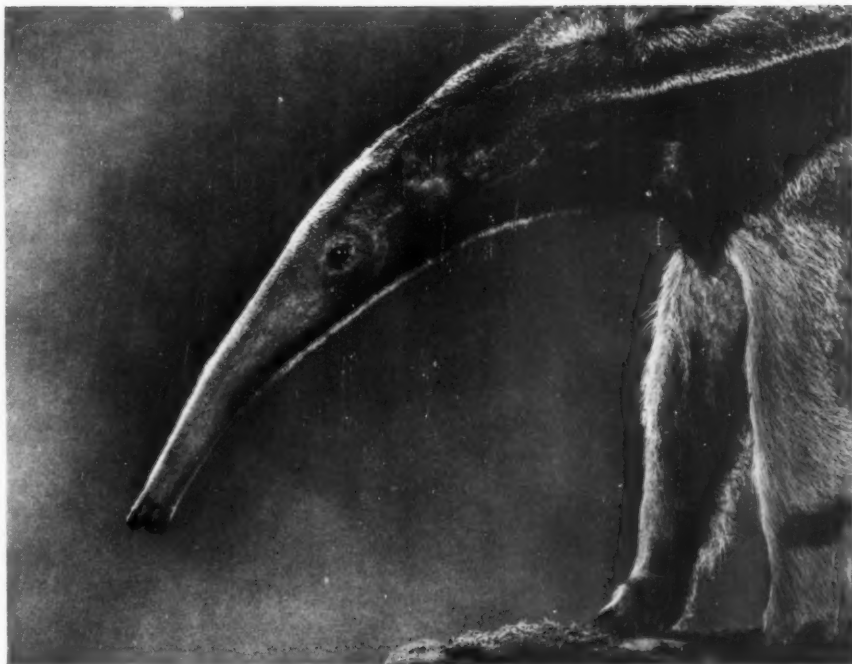
At the other end of the scale from all these glorious noses we find some that are sadly deficient, but man, not Nature,



After Gould and Pyle

THOMAS WEDDERS

The Yorkshire man whose seven and one-half inch nose was his means of livelihood



THE ANT BEAR
Myrmecophaga

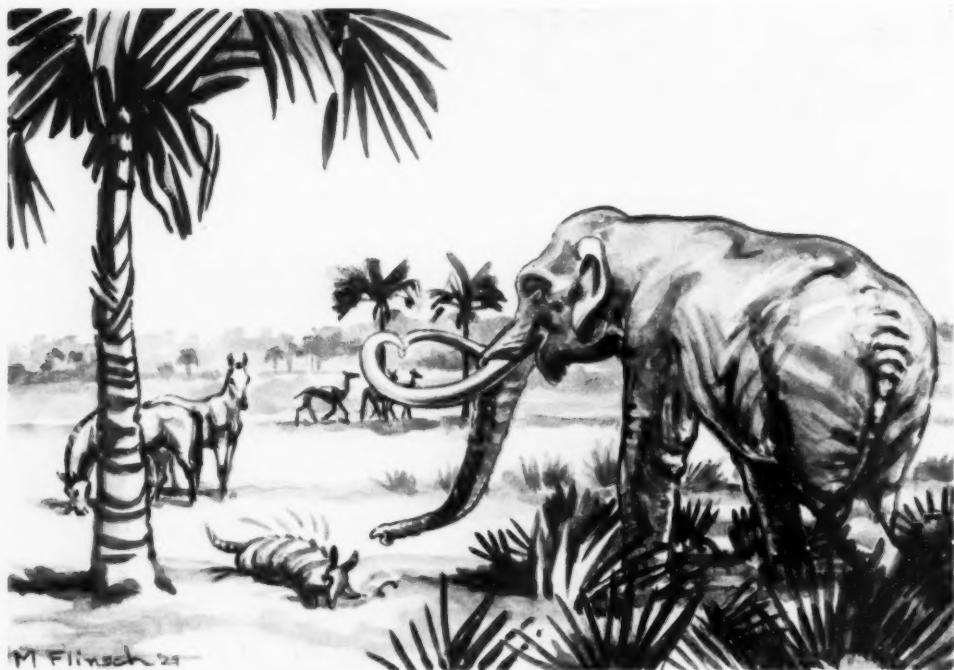
A nose that roofs a record tongue. Note the smallness of the creature's mouth

has been responsible for this deficit. Those achondroplastic dwarfs, the bull dogs and Japanese spaniels, are equipped with noses so poor that they are subject to respiratory diseases more than is the common lot of dogs. Without the solicitous care of men they could not survive as a race.

Noses of most mammals are equipped to a variable degree with long stiff hairs that telegraph touch impulses to the body coming in contact with another object. Rabbits, mice, and cats, whose

habits are largely nocturnal, find use for their whiskers in warning them of things they do not see. The meadow mice find their vibrissæ of use to them in following tunnels when they are in haste. Squirrels are guarded by these hairs in their precipitous flight among the branches. The walrus may find his stiff imposing brush of service to him when raking among the mollusks of the muddy ocean floor.

What's in a nose? More than at first sight appears!



Florida During the Pleistocene or Ice Age. From a Drawing by M. Flinsch

HUNTING EXTINCT ANIMALS IN FLORIDA

The Difficult Science of Finding the Remains of Animals of Ages Long Past,
and the Reconstruction of Pictures of Those Ages

By GEORGE GAYLORD SIMPSON

Associate Curator of Vertebrate Paleontology, American Museum

THE Beastes best known in this Country are Stagges, Hindes, Goates, Deere, Leopards, Ounces, Luserns, divers sortes of Wolves, wilde Dogs, Hares, Cunnies, and a certaine kinde of Beast that differeth little from the Lyon of Africa."¹

Lovers of warmth, escaping from snow and ice by migrating to Florida, follow an example hundreds of thousands of years old. In the Ice Age, when great glaciers gathered and slowly pushed their way southward, the animal life of our continent was compelled to surge southward before them. Even in that cold time, the ice sheet at its farthest advance was some five hundred miles north of

Florida, and that favored peninsula, while doubtless less clement than now, offered to life a haven from the devastating cold. In the West, a pathway lay open to the tropics, but in the East, Florida, jutting into the sea, was the last refuge for southward migrants. Here were impounded myriads of animals, some familiar, many strange in this setting. Recent field and laboratory work has been devoted to bringing to light the remarkably rich and varied extinct faunas of the State.

This conception of an ancient prehistory in this part of North America will be novel to many. It is a common idea that Florida is an appendage, a sort of happy afterthought, recently constructed

¹Hakluyt "The Beastes of Florida," *Principal Navigations, Voyages, Traffiques and Discoveries of the English Nation*, Hakluyt Society Edition, Vol. VIII.



SABER-TOOTH TIGER AND CAPYBARA

One of the most ferocious of Pleistocene mammals was the terrible saber-tooth tiger. In a cave in Citrus County, Florida, remains of this animal have been found, and this drawing suggests such a situation as might have caused the saber-tooth to entrap himself in a cave from which, after his meal, he was unable to escape. From a drawing by M. Flinsch



MIocene THREE-TOED HORSES AND A SEA COW

The three-toed horse flourished during the Miocene period that preceded the Pliocene and Pleistocene. It was not until the Pleistocene, many millions of years later than the Miocene, that the horse finally became one-toed, practically as we see him today. Drawing by M. Flinsch

of mud and sand, shell and coral. In reality, it is built on rock and even its surface formations record a geologic history of millions of years.

The oldest of these surface formations is of Upper Eocene Age, perhaps fifty million years old. This formation, a limestone slowly soluble in percolating ground water, is responsible for some of the most characteristic features of Florida, including many of the lakes and most of the large springs, and it also furnishes most of the underground water supply for communities and farms. To the student of extinct life, however, it is of little direct interest. Deposited in the sea, far from land, it contains only one known mammal—a primitive relative of the whales (*Basilosaurus* or *Zeuglodon*).

Deeply buried where only the deepest wells reveal its presence, there is a land surface beneath Florida much older than

the marine rocks of the Upper Eocene, but the definitive emergence of the peninsula probably did not begin until after the Eocene. Since that time, land and sea have fluctuated greatly, but the land has generally tended to increase to its present area.

Four successive vistas of land life in Florida are afforded by the fossils so far found. Most recent and most complete is that of the Pleistocene, or Ice Age, which ended only some twenty-five thousand years ago. Far older than this are the mammals from the earlier part of the preceding epoch, the Pliocene, and finally, still earlier, are two little known faunas from the next older epoch, the Miocene, one from the early and one from the middle part of this division of geologic time.

About fifteen years ago the first glimpse of the oldest of these land faunas



AN AMPHIBIOUS RHINOCEROS OF THE PLIOCENE AGE

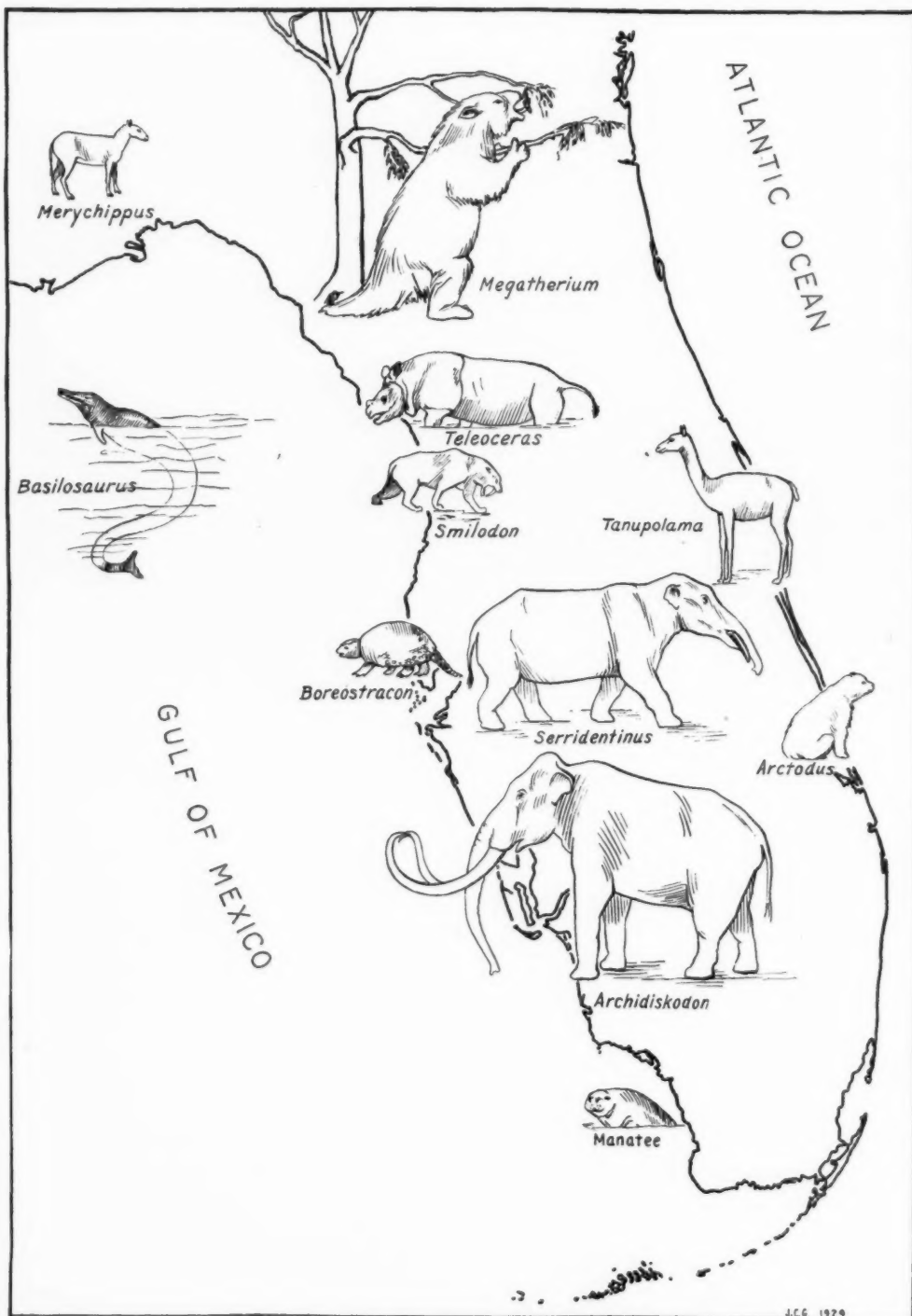
The Pliocene, preceding the Pleistocene or Ice Age and following the Miocene, also preceded the appearance of man upon the earth, but mammals of many species and of great size were common. From a drawing by M. Flinsch

was accidentally gained in digging a well north of Tallahassee. Here three-toed horses, primitive deer, and an ancient type of dog were found in rocks of lower Miocene Age. Logically beginning a prehistoric hunt here, we recently relocated the spot after much search and inquiry—only to find the well filled in and neatly covered with grass! Ruefully the state geologist, Mr. Herman Gunter, and the writer gazed at the spot, where fifty feet below an important fossil stratum lies buried.

Incidentally, fossil hunting in Florida often calls for all the talents of a sleuth, but fortunately is not always so futile as in this case. For instance, we almost revived the reputedly riotous past of Mulberry when we searched through the town with the police force guiding us from the running board. With this help, we located a fine serrate-toothed mastodon

jaw which had been found some time before and now was in private hands. After some persuasion it was transferred to the ownership of the American Museum. But this belongs some weeks later in our journey and some millions of years later in geologic history.

For our next vista of ancient land life, that of the middle Miocene, we went to the fuller's earth mines northwest of Tallahassee, which are also (but quite unintentionally) fossil mines. In certain strata just above the fuller's earth or between two beds, fossil bones and teeth are fairly common. Here we found bones and teeth of a Miocene type of three-toed horse, *Merychippus*, as well as remains of primitive deer, camels, and rhinoceroses, and of a large doglike animal of a type previously unknown in Florida. These beds were laid down in the sea, or in estuaries, and the remains of land animals



SOME PREHISTORIC ANIMALS OF FLORIDA

Drawing by John Germann

Here are given restorations of some of the many fossil animals of Florida. Those on the land stand near points on the map where their remains have been found. From the oldest deposits of the state, those of the Eocene, comes the aquatic, whalelike *Basilosaurus*, here shown as swimming in the Gulf of Mexico. *Merychippus*, a small three-toed horse, is the commonest mammal of the Miocene Epoch. From the next epoch, the Pliocene, came the amphibious rhinoceros, *Teleoceras*, and the serrate-tooth mastodon, *Serridentinus*. Of the very numerous Pleistocene, or Ice Age, animals, a giant ground sloth (*Megatherium*), a saber-tooth tiger (*Smilodon*), a long-footed camel (*Tanupolama*), a glyptodont or tortoise-armadillo (*Boreostracon*), a short-faced bear (*Arctodus*), a mammoth (*Archidiskodon*) and a manatee, or Florida sea cow, are shown.



Photograph by George Gaylord Simpson

EXCAVATING A MAMMOTH

Carl Sorensen, of the American Museum staff, is shown beginning work along a canal bank near Bradenton. From this spot were recovered parts of two or more Columbian mammoths, as well as remains of a fossil horse, a bison, and a capybara

must have been drifted in by streams and currents, a fact which explains their scattered and usually broken condition.

More complete, because it lived in marine or estuarine waters, was a skeleton of a Miocene sea cow. This had been exposed, just before our visit, by the rude touch of dynamite and a steam shovel. When we arrived, work here was suspended, a trainload of dirt was dumped into the water below it to give us footing, and then a spur of the mine railroad was moved out of the way in order that we might salvage this important specimen,—unusual coöperation for which we have to thank the mine superintendent, Mr. R. H. Hopkins, and others.

Fragments of sea-cow ribs, easily recognized by their plump shape and extremely dense bone, are common in many Floridian deposits from the Miocene

onward. The lagoons and estuaries of the State have long been inhabited by various species of these ungainly but inoffensive aquatic beasts, as some of them still are today.

Knowledge of land life in Florida toward the beginning of the succeeding epoch, the Pliocene, is chiefly a by-product of mining for phosphate rock. In the north central part of the state (where the rhinoceros is shown on the accompanying figure) these are of land formation, but the more southern phosphates (where the serrate-toothed mastodon is shown) although probably found in a shallow sea near the shore, are equally productive of land mammal remains in places. A relatively small part of the life of that time is known, but it reveals an even stranger fauna than the previous epoch and well illustrates some principles



Florida State Geological Survey

WHERE FRAGMENTS OF THE THREE-TOED HORSE WERE FOUND

In this abandoned and mined-out pit of the Cummer Lumber Company near Newberry, Florida, was found part of the upper jaw with four teeth of *Merychippus*, the three-toed horse. The specimen was presented to the Museum of the Florida Geological Survey by Mr. Weston in March, 1929



Photograph by George Gaylord Simpson

ENTRANCE TO SABER-TOOTH CAVE

This cave near Lecanto in Citrus County was explored for fossil animals in 1928 by Walter W. Holmes, who stands at the head of the ladder. There are two openings on the surface that lead into a large subterranean chamber



AN OPEN PALMETTO GLADE IN FLORIDA

A typical scene in Florida. While many fossil remains may lie beneath surfaces such as the above, it is only by finding actual signs of the bones in eroded sections or in mines or other diggings, that the palaeontologist can complete his investigations



Florida State Geological Survey

A HAMMOCK NEAR PORT ORANGE, FLORIDA

Such heavy growth as this often proves a serious handicap to the fossil hunter, for it may easily conceal important remains that otherwise would help to piece out the record of life that existed during past ages



Photograph by George Gaylord Simpson

MINING FULLER'S EARTH AND MERYCHIPPUS TEETH

This line at Midway is operated for fuller's earth, but to the fossil hunters its most important products were the teeth and bones of *Merychippus*, a three-toed horse of the Miocene Epoch, which were found just above the fuller's earth on the level of the bench seen above the steam shovel

of life succession. Three-toed horses remain, but they have evolved into a new type, *Hipparion*, last of the fully three-toed horses. Similarly the rhinoceroses and camels are larger and more highly developed. These are old American families which antedate Florida itself. At this stage first appears a new group, wandering far from its original home in Africa by way of Europe and Asia, that of the mastodonts. These animals have not been found in any earlier deposit in Florida, probably because they did not reach this part of the world until well into Miocene times, but here they are fairly common. Two types occur: a primitive true mastodon (*Pliomastodon*) and several closely related species of serrate-toothed mastodonts (*Serridentinus*). The former was a forerunner, perhaps a direct ancestor, of the well known American mastodon (*Mastodon americanus*) of the Ice Age. It differed from this later type most noticeably in retaining small tusks

in the lower jaw, as well as the large tusks in the skull. The serrate-toothed mastodonts also had four tusks, of more nearly equal size, long lower jaws, and complex cheek teeth especially adapted, in the Florida species, to crushing and grinding fibrous vegetation. A large bear-dog (*Hyænarctos*) nearly completes what is known of this fauna.

Relatively scanty as our knowledge is of these earlier land faunas of Florida, its importance is great. By comparison with fossils from other parts of the world, they fix the age of the deposits in which they occur, deposits of economic as well as scientific importance because of the fuller's earth and phosphate rock. From a broader point of view, this is almost all that we know of mammalian life in the eastern half of the United States before the Pleistocene. It is reassuring to find that they agree in a general way with the much better known contemporaneous faunas of the western half of the conti-

nent. This indicates that Florida was then already a connected part of North America, and also that what we know of western fossil mammals probably gives us a fairly adequate idea of at least the plains life of this climatic zone throughout the breadth of the continent.

One question is so often asked that it demands a digression. Since fossil animals are usually sought in deserts and among dissected hills, how does it happen that so many are found in humid and low Florida?

In order to find fossils two things are necessary. In the first place, obviously, the animals must once have been present, and their remains must have been buried and fossilized. Florida was exceptionally favorable in these respects. Its mild or semi-tropical climate and its abundant

verdure were peculiarly adapted to supporting great numbers of animals. Furthermore, the first essential of fossilization is rapid natural burial, and this is much less likely to occur in an upland, which is being eroded, than in a lowland, like Florida, where deposition of mud and sand is more rapid and permanent and where marshes and sluggish streams abound. The conditions which still prevail in Florida today are probably very like those which obtained in many of the richest fossil areas when the fossil-bearing beds were being deposited, even though the region be elevated or arid now.

The second essential for finding fossil animals is that their remains must be partly exposed and visible. Paleontologists possess no mystic sixth sense



Photograph by George Gaylord Simpson

PEACE RIVER

Peace River, between Gardner and Zolfo, is well named. The rock ledge along the bank of this beautiful stream is of limestone, formed in the sea during the Miocene Epoch. Lying on it may be seen a bed of gravel which contains numerous fossil sea-cow bones and teeth of extinct mammoths, horses, bison, and other animals of the Ice Age



Photograph by George Gaylord Simpson

WAKULLA SPRING

Where soft, easily soluble limestone lies close to the surface, the underground formations of Florida are almost like a sponge, and from them flow some of the largest springs in the world. In the clear water of Wakulla Spring the bones of a mastodon were found some years ago. Even today the spring has a weird almost prehistoric aspect with its fringe of gaunt, moss-hung cypresses crowded with perching buzzards

which enables them to find hidden bones. They never dig unless they know very well that bone is there, and they usually have no way of knowing except by finding some exposed. In humid regions fossils may be abundant, as they are in Florida, but very difficult to find because of the absence of eroded "bad land" areas which are often so common in a drier climate. Most of Florida's ancient fauna would still sleep undisturbed were it not that man has dug into the ground so extensively for other purposes. Although usually little suspected, Florida supports a considerable mining and quarrying industry.

The essential part that mining has played in the discovery of some of the older fossils has already been suggested. The hundreds of drainage canals that cut through the superficial strata are equally important, especially for Pleistocene remains, which here are often (but not necessarily) less deeply buried than those of the Miocene or Pliocene.

So we come once more to the oldest winter residents, the animals of the Pleistocene Epoch, which was an Ice Age for much of the rest of the world. Remains of Pleistocene mammals are very widely scattered through the relatively shallow deposits of sand, clay, and muck of the State, and they reveal an amazingly rich fauna. For instance, about five years ago, Mr. Walter W. Holmes found near St. Petersburg a few fragments of fossil bone in a canal spoil bank. Following this up for several successive seasons and digging into the bank where the dredge had thrown out most bones, he uncovered a fauna at one locality which includes nearly fifty species of land mammals. In recent times the entire peninsula of Florida has been inhabited by less than thirty species.

Perhaps no better idea of the amazing life in Florida during the Pleistocene can be given than by a synoptic list of the species of land mammals so far discovered.

Such a list looks formidable and dull, but a moment's thought should find much that is interesting in it. Space is lacking here to do more than suggest a few of these points. For one thing, the length itself is of interest, since it shows that in the Pleistocene there were more than twice as many different kinds of land mammals in Florida as now. The very presence of lions, saber-tooth tigers, camels, mastodons, and mammoths, among others, is striking. Then there is the picture of

animals now characteristic of other parts of North America crowded in here during the Ice Age, such as the western pocket gopher, beaver, red fox, elk, and bison, to mention only a few. Other animals were immigrants from South America, including the porcupine, capybaras (largest of living rodents), and all of the edentates, while some, although anciently natives of North America, have their nearest relatives of today in Central or South America, such as the short-

PLEISTOCENE LAND MAMMALS DISCOVERED IN FLORIDA TO DATE

*Species extinct or no longer living in Florida

MARSUPIALS—

Didelphis virginiana, the common opossum.

INSECTIVORES—

Scalopus aquaticus, common mole.

Cryptotis floridana, Florida short-tailed shrew.

Blarina brevicauda, Everglade short-tailed shrew.

RODENTS—

Sylvilagus floridanus, Florida cottontail.

Sylvilagus palustris, marsh rabbit.

Sciurus carolinensis, gray squirrel.

Geomys floridanus, Florida pocket gopher.

**Thomomys orientalis*, an extinct relative of the western pocket gophers.

Reithrodontomys, a species of harvest mouse.

Oryzomys palustris, rice rat.

Sigmodon hispidus, cotton rat.

Neotoma floridana, Florida wood rat.

Neofiber alleni, round-tailed muskrat.

**Synaptomys australis*, southern mouse-lemming.

**Castor*, a species of beaver.

**Castoroides ohioensis*, the giant beaver.

**Erethizon*, a species of porcupine.

**Hydrochoerus holmesi*, Holmes' capybara.

**Hydrochoerus pinckneyi*, giant capybara.

CARNIVORES—

Euarctos floridanus, black bear.

**Arctodus floridanus*, extinct short-faced bear.

Procyon lotor, common raccoon.

**Procyon nanus*, extinct dwarf raccoon.

Mustela peninsulæ, Florida weasel.

Lutra canadensis, otter.

Spilogale ambarvalis, spotted skunk.

Mephitis elongata, striped skunk.

Urocyon cinereoargenteus, gray fox.

**Urocyon seminolensis*, extinct gray fox.

**Vulpes palmaria*, extinct red fox.

**Canis ayersi*, dire wolf.

**Canis riviveronis*, extinct coyote.

**Felis veronis*, extinct Florida lion.

Lynx rufus, bobcat.

**Smilodon floridanus*, saber-tooth tiger.

EDENTATES—

**Megatherium*, a species of giant ground sloth.

**Megalonyx*, probably two species of large-clawed ground sloths.

**Myiodon harlani*, Harlan's ground sloths.

**Tatu bellus*, armadillo, like that still living in Texas but larger.

**Chlamytherium septentrionale*, giant armadillo.

**Boreostracon floridanus*, glyptodont or tortoise-armadillo.

UNGULATES—

**Equus*, probably three species of one-hoofed horses.

**Tapirus*, two or three species of extinct tapirs.

Odocoileus osceola, white-tailed deer.

**Odocoileus sellardsiae*, extinct deer.

**Cervus*, a species of elk.

**Platygonus*, a species of extinct crest-toothed peccary.

**Mylohyus*, four or five other extinct species of peccaries, mostly of this genus.

**Tanupolama mirifica*, extinct, small, long-footed camel.

**Camelops*, a species of larger, heavy-footed camel.

**Bison*, a species of extinct bison.

PROBOSCIDEANS—

**Mastodon americanus*, American mastodon.

**Archidiskodon columbi*, Columbian mammoth.

**Archidiskodon imperator*, imperial mammoth.

faced bear (related to the South American spectacled bear), the peccaries, and the camels (related to the llama). Any one of these, or of a dozen other points that might be mentioned, is full of interest, but each would require an article longer than the present one for its discussion.

The hunter of fossils brings animals back to life, rather than killing them. In Florida he finds an unrivaled field for big game and small, and from his trophies he slowly reconstructs a picture of Florida during the Ice Age. The setting is probably not very different from that of today: pine and palmetto flatwoods, jungle-like hammocks, cypress-bordered lakes and ponds, sluggish streams and lagoons, rolling dunes and low hills.

Through these scenes move myriads of animals large and small. Along water-courses and in the marshes and prairies

rodents are especially numerous, the most exotic being the large water-loving capybaras and still larger giant beavers. Herds of horses, bison, camels, and mammoths thrive in the grassy prairies and open woods. Browsers and more strictly forest-loving animals, such as the peccaries, deer, tapirs, and mastodons, are scarcely less abundant. Ungainly ground sloths walk about on their knuckles. Glyptodonts and their smaller cousins the armadillos are common in the more open country. All is not paradisaical, however, for flesh-eaters of all sizes and tastes also abound, from the small gray foxes and tiny weasels to the packs of great dire wolves, the lions, and the saber-tooth tigers.

Florida is now civilized, but beneath her paved roads and her subdivisions lie the relics of a more savage—and a more interesting—past.



Photograph by George Gaylord Simpson

EXPLORING AN ANCIENT SEA

Some millions of years ago this spot near Quincy was a shallow sea where sea cows, forerunners of the living manatees, went their calm ways. In this fuller's earth mine was discovered an unusually complete specimen. Mr. Gunter is pointing to the few protruding rib fragments which betrayed its presence

ANIMALS IN ORCHESTRATION

How Musicians Have Used, in Their Music, Interpretations of the Sounds
and Movements of Animate Nature

By MYRON ACKLAND

WERE all the popular writings on natural history to be compressed within some enormous work, it would not be a complete edition unless one short chapter were devoted to a recital of the part animals have taken in the compositions of the world's better known musicians.

It is possibly a novel idea to some that animals have taken any appreciable part in the mental imagery of the musician; but that this has been frequently done is not news to the observant and confirmed music lover. It is true that not all composers of merit have utilized animals, or the sounds and movements of animals, in the development of their themes. The notable exceptions are the three big B's of music,—Bach, Brahms, and Beethoven. In this trio of greatest musical genius, Beethoven alone used an animal motif and he did so only twice. These appear in his "Song of the Skylark" and in his well known "Pastoral Symphony" in which is heard, from wind and string, imitations of the nightingale, the cuckoo, and the quail (genus *Coturnix*).

It is a well-known fact that Beethoven was a lover of nature; yet who can attempt to explain why this great love was allowed to voice itself in but two of the products of his genius? Bach and Brahms may have been as profound in their love of nature as Beethoven, but it was never revealed in any of their works.

In contrast with Bach and Brahms, there was a perfect marvel of versatility in the musical treatment of animals by Saint Saëns. This composer not only admired nature and animals, but knew

them, perhaps not in a scientific way, but in a supremely poetical way. In his "The Carnival of the Animals" there are represented not less than a dozen members of the animal kingdom. He introduces the King of Beasts, which, to the rhythm of a "Royal March," seems to be striding majestically up and down his cage, roaring as only he can. There is a swiftly moving passage intended to suggest the rapid pace of the wild ass. One hears also the musical cackling and crowing of hens and roosters. A much retarded passage is reminiscent of no one else than His Slowness, the Turtle; and, in a different passage, gracefully bounding chords call to mind the kangaroo. A lumbering, clumsy movement is, for the nonce, an elephant. A bray from the brasses can mean none other than he of the "Long Ears." Sinuous and full of grace are the bars that suggest the fishes. A "cuckoo, cuckoo," as plainly as one could desire, together with an entire chorus of other musical chirps and warblings, transports the hearer for a moment to a veritable fairy forest of feathered songsters. Finally, in this symphony, a soft, low, but majestic movement conjures up in one's mind a vision of that epitome of elegance—a swimming white swan.

Birds are found frequently in the realm of music. Quite often, as might be expected, they go hand in hand with the author's reaction to the advent of spring: witness, "On Hearing the First Cuckoo in Spring," by DeBussy; "Spring," by Vivaldi; and "Woodland Sketches," by MacDowell.

Among other notable pieces containing the bird motif are "Sounds from the Forest" in Wagner's *Siegfried*: "The Pines of Rome," by Respighi; Franz Liszt's "The Nightingale"; and Beethoven's "The Song of the Skylark." Caesar Franck in his "St. Francis of Assisi" has written perhaps the most delightful composition of all in which birds play a predominating part.

In the order of frequency with which animals are met in the realm of music, horses rank next to birds. Peculiarly, though, with the possible exception of Wagner in his "Troll King" (*Erlkönig*), no one seems to have used the horse in the singular; rather always in pairs, teams, or galloping troops.

In "Phaëton," by Saint Saëns, by the use of pure tempo, employing all the instruments of the orchestra, the composer has powerfully wrought the picture of Apollo's runaway steeds, as with galloping gait, heaving hoofs, and foam-flecked sides, they draw the great sun-chariot in a mad, dangerous race across the sky. Not less vivid than in "Phaëton" are the horses of Richard Wagner which are the central motif of his "Ride of the Valkyries" as they plunge, under the wild and eager urging of the flying-haired Amazons, down the vale of dead and dying heroes to the famed Valhalla of Scandinavian mythology. Similar in treatment to these two compositions is "The Ride to Hell" by Berlioz. In Mendelssohn's "Midsummer Night's Dream" there is a remarkably lifelike "hee-haw, hee-haw" suggesting unmistakably a near relative of the horse, and coming from poor Bottom.

Among the daintiest, lightest, and, in a way, the most "fetching" sketches are those in which musicians have given us their understanding of insects. There are two of these on the bee, "Bombola" by Hadley, originally a conductor; and Rimsky-Korsakoff's "The Flight of the Bum-

ble Bee." The latter, especially, remains virtually unmatched for its scintillating airiness and sheer charm of expression. A darting, zigzag piece indeed is the "Dragon Fly" by Josef Strauss. And Liadow, by means of a highly pitched violin score, has rendered both suggestively and humorously "The Dance of the Mosquito." In this category, though it may not be strictly an orchestral selection, belongs also Chopin's "Papillion"—the nearest that we shall ever come, perhaps, to a musical butterfly.

It is strange, in view of the fact that the sheep is such a well known and almost ubiquitous animal, that its bleating is encountered only once in music and that is in Richard Strauss' "Don Quixote."

Some animals have been suggested by inference. For instance, in both "The Hunt in the Black Forest," and in MacDowell's "Woodland Sketches" there is sounded the huntsman's horn. From this there can be envisioned at the listener's discretion the fleeing quarry,—fox, stag, or boar.

Erik Satie, a satyric from the modern French school, has given us something rare from the annals of nature, "The Laugh of a Lobster." And Stravinsky, borrowing from a page in a book of folklore, has painted in most lurid tones, a most marvelous "Firebird."

Another musical curiosity is Kodály's "Harry Janos Suite" in which is heard a very disdainful *sneeze*—one instance of the direct imitation in music of the human animal.

This by no means purports to be a complete list of instances in which musicians have honored animals by weaving them into the fabric of their dreams,—for the artistic and æsthetic works of man have borrowed, and will continue to borrow, for dramatization in music, as well as in other arts, the freedom, majesty, beauty, power, and grace of the animal world.



A photograph of the model of the new Arctic bird group in the American Museum

BIRDS OF LITTLE DIOMEDE

How the Newest Group in the American Museum Was Erected. Gathering the Data. Work in the Field. The Problems Faced by the Artist in Transferring His Impressions of a Remote Arctic Island to the Museum Visitor Through the Medium of Paint, and Plaster, and Mounted Birds

BY FRANCIS L. JAKUES

Assistant in Preparation, American Museum

IN Bering Strait, a few miles south of the Arctic Circle, lie two granite islands. The larger, the Big Diomedé, seven miles long, is Russian; the Little Diomedé, much smaller, is American. Here where the East and the West are but little over two miles apart, the East is to the West, and the West is to the East! The International Date Line, here a line of convenience, swings east of the 180th meridian and passes between the two islands. The days are born on the Big Diomedé, follow the sun around the earth and end forty-eight hours later on the Little Diomedé!

Here probably, was the site of the land bridge where man crossed from Asia to America. Here the walrus, which pass

northward at the edge of the ice in the spring, and southward in the autumn, are intercepted by the Eskimos, who have a village on each of the islands. Here we saw great rolling windrows of shearwaters, in the flight peculiar to them, passing through the Strait into the Arctic Ocean in July. These were visitors from the far southern oceans spending with us the southern winter. Here also, at the Little Diomedé, was collected the material for the Bering Strait Bird Group with which this article is concerned. This will complete the series of habitat groups of North American Birds at the American Museum of Natural History, under direction of Dr. Frank M. Chapman.

The collection of this group, among



THE ROCKS OF LITTLE DIOMEDE

One of the numerous photographs taken by Mr. Jaques as studies on which to base the group

others, was made possible through the generosity of Mr. Charles H. Stoll and Mr. Harold McCracken, in the summer of 1928. Mr. Harold E. Anthony, curator of mammals, Edward Weyer, archeologist, and Andrew Johnstone and myself from the department of preparation represented the Museum on the Stoll-McCracken Expedition to the Arctic on the schooner "Morrissey," under command of Captain Bob Bartlett.

We first approached the Diomedes July 27. Due to a broken propeller shaft which delayed us at Teller, Alaska, for more than two weeks, we were behind our schedule. The short Arctic summer waits for no one, consequently

the time which could be given to the collection of materials for a bird group promised to be short. Furthermore, an anchorage near an exposed island might have to be abandoned quickly if the wind changed. The wind was high and the water rough when we arrived. No landing could be made. Passing between the islands, we lay overnight in the shelter of the Big Diomede. Once we nearly lost the island in the fog, as the tide,—which ran continuously from the southwest during our entire stay,—and the wind, proved almost too much for us. The cold gray heights of East Cape could be seen occasionally through the mist and rain, twenty miles to the northwest.

The following day was reasonably calm, how-

ever, and in the late afternoon we anchored near the Eskimo village on the Little Diomede, there to remain until early the second morning.

At a distance the island seemed disappointing group material to an artist who hoped for beauty as well as realism. The slopes looked gray and colorless: their size we could not judge, since there was nothing with which to compare them. Only when we approached the base of these rocks in a small boat did the majesty and beauty of these gigantic granite cliffs impress us.

What had seemed from a distance dull and drab, now proved to be many-colored and beautiful. Rich green vege-

tation followed the rock slides down from the upper slopes toward the water's edge. At the base the slow rise and fall of the dark water was transformed to green and white where it met the opposing granite. Myriads of birds flew overhead and around the great walls, or perched in long lines on the ledges.

Kittiwakes, slim, graceful birds, which made the larger gulls look awkward, had the preferred nesting sites. They selected the most inaccessible projections on the verticle rock faces at the base of the slopes. The murres, which build no nests, had selected ledges sufficiently flat so the single egg would not roll off and be smashed on the rocks below. Often, on a single ledge but a few inches wide, scores of murres were seen, standing shoulder to shoulder. These and the kittiwakes were intermingled on the cliffs, the presence of either due to the nature of the projection on which it rested.

The puffins, of which there were two species, nested in crevices or burrows which could not be seen from the water. We saw them singly or in small groups as far up the sides of the slopes as the binoculars made them visible. Pigeon guillemots were more often near the water on projecting rocks. They, too, nest in inconspicuous places. Their numbers were not great. The birds previously mentioned, together with a few glaucous gulls and cormorants, made up the conspicuous large birds of the lower slopes and verticle cliffs.

Above, over the entire surface, in crevices and beneath rocks, were the invisible nests of the auklets. There are three species of these, the crested, the least, and the paroquet. Their numbers were legion. "Millions" seems an inadequate word. At dusk, which comes late here in July, and during the morning hours, the noise of their wings was like



PREPARING BIRD SKINS ON BOARD THE "MORRISEY"

The birds collected for the group were taken near that portion of the island that is depicted in the group



MR. JACQUES PREPARING A PART OF THE FOREGROUND

Habitat groups are generally made up of a foreground and a painted background. Here the artist is constructing a "granite" rock from a wood frame, wire mesh, plaster, and paint

the sound of a gigantic surf. The air as high as they were visible was filled with their fluttering forms. Never before had I seen so many living creatures,—never before had numbers been so impressive.

A landing here was quite impossible. There above me, almost in reach of my hand, was the elusive material which I hoped to reproduce in a museum group. How was I to secure it?

The impressions of what should be shown come through all the senses. They must be given to the observer through one sense only, that of sight. The image which greets him must necessarily be static also, quite different from the living, moving panorama which greets the observer in the field.

My problem was to suggest to the museum visitor, through sight alone, some sense of the flying gray clouds, the wind-whipped sea, the cool salt air, the

towering cliffs with their teeming bird life, and the savage loneliness of the scene.

The group space is 20 feet in width, 7 feet from front to back, and 12 feet high. If all this space could be used for rock work, upon which was placed the mounted birds, the maximum area would be no more than 12×20 feet, pitifully small in comparison with the great rock masses before my eyes. Furthermore, such a group would have no background, and no indication of the sea, since a nest within that distance of the water would be washed away by the frequent storms. If we chose the opposite extreme and looked outward to the sea, our group would be all painted background. Obviously we must combine the two, looking along the face of the rocks from a point several feet above the water.

A landing was possible only at the Eskimo village. From there an attempt

to reach, overland, a suitable locality might result in the loss of precious time, possibly in failure. I chose a method which seemed to promise more immediate results. In a launch, with two men from the vessel, we approached the most promising localities as closely as possible. The water was deep, and as in deep water alongshore a heavy swell may rise and fall without breakers, we viewed some magnificent spectacles as the great masses of green water rolled in and out of grottoes and crevasses, and over the masses of broken rock at the cliff base.

From the launch many photographic exposures were made, the character of the rocks closely studied, and sketches and color notes secured. The birds could be studied best from the launch, and their habits noted. We created much less disturbance than would have been the case had we been ashore, and their

behavior was that of a normal colony. These few hours spent in a tossing launch off the shores of an Arctic bird rookery I shall always remember as one of the most interesting experiences of my life.

In the meanwhile Mr. and Mrs. Stoll and Mr. Anthony had collected sufficient birds for the group, and all members of the party used every available minute in the preparation of the skins. So our mission was accomplished.

Three times we returned to the islands, once to find them surrounded by ice which had been driven down from the northern coast of Siberia by the storms, once to anchor overnight off the village, and once, on our parting visit, to seek their shelter in a storm.

Back in New York again at last, we faced the problem of how best to use the material we had obtained. The first step in making a museum group is the



MOUNTING THE BIRDS IN THE MUSEUM

Raymond B. Potter, who was responsible for the proper mounting of the birds of the group, is shown here at work in the Museum's department of preparation



AT WORK ON THE GROUP

This gives a good idea how the plaster "rocks" look during the process of building the group

construction of a scale model. The model made for this group was about 30 inches long, or one and one-half inches to the foot. Modelling wax was used for the rocks, the birds carved of balsa wood and colored, and the background painted in miniature. Most of the major problems can be solved in the model, as it is tractable, and changes are readily made. With this as a basis, construction of the large group was much less difficult.

We have placed the rockwork which represents the cliff to the left-hand side of the space. This is carried back, in the painting or background, to the middle distance. In the foreground, more rocks,

low down, cover the remainder of the floor space.

The rock which composed the cliff to the left was built in three sections, arranged to fit together when placed in position. The frame work is of wood, over which a coarse wire netting is placed. Shaping this was one of the most difficult parts of the work, for the netting tends to take geometrical forms. It is modelling with a very refractory material whose surface contour is not easily seen. Measurements from the scale model were of great value here.

This netting was covered with burlap and plaster, and the surface modelled in plaster. Later it was surfaced and colored, and the rockwork was complete.

The problems of design in this rock were complex. It was necessary that it afford numerous horizontal ledges for the birds, which had to be placed in an advantageous position as seen from the front of the group. It must also give the effect of height and verticle cleavage. The birds are arranged in closely massed groups, leaving much of the rock surface free, to increase the apparent height and size.

The painted background must carry a large share of the burden in this group. The area shown is many times greater than that of the foreground. Where sixty birds are shown in the foreground, hundreds will be painted into the background.

We chose to represent a day when

spots of blue show through a gray sky, with the threat of misty rain. The site of the group is the south end of the Little Diomede, looking southeast. A fresh wind is blowing from the south, and a pale sunlight falls on the rocks of the foreground. In the distance Cape Prince of Wales, the northwestern extremity of the North American mainland, is visible, "hull down" across the Strait.

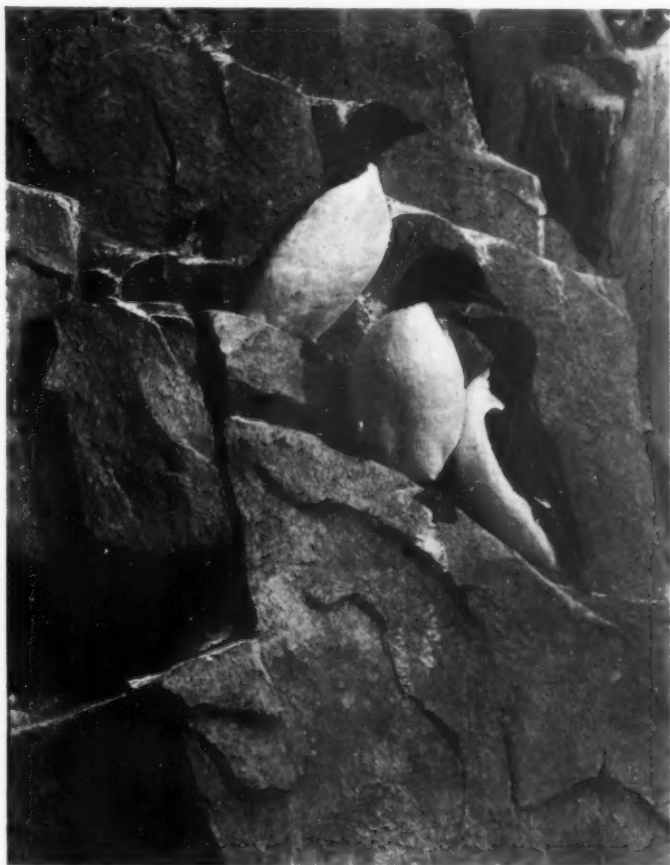
About sixty-five mounted birds will be used in the group. Each bird is mounted to fill a certain place according to the scale model. It is fitted to the rock in its proper position and allowed to dry, after which it is numbered according to a chart. Then it is removed, to be replaced in position later, when the final assembly of the group material is made.

Few people realize the amount of skill and patience required to produce a well mounted bird. Every feather must be scraped free at the base, inside the skin, to permit it to be adjusted properly, and remain so, when the specimen is finished. The feathers must be thoroughly washed and cleaned, and afterward dried with the aid of sawdust and much beating, until every feather once more spreads itself as it did on the living bird. The preparator must not only know exactly the effect he wants, and the somewhat indirect methods he must use to secure it, but he must have great skill with his fingers, a deftness which can come only

through years of experience. My colleague, Mr. Raymond B. Potter, who mounted the birds for this group, has done splendid work from the rather indifferent looking material with which we returned. If the group falls short of perfection it will not be due to the appearance of the birds.

The group will be opened for exhibition at about the time this article is published.

Problems to be met and solved in the making of museum groups are many and varied. Not only does the preparator have the same problems of composition and arrangement that the artist has, but the composition, as viewed through the



A DETAIL OF THE GROUP

A bit of the group that has practically reached completion. The birds are Pallas murre (Uria lomvia arra)



A PHOTOGRAPH OF THE AMERICAN MUSEUM'S NEW ARCTIC BIRD GROUP

Complete though this scene may appear, the finished group shows many additions that have been made since this photograph was taken. By comparing this photograph with that of the model of the group which appears above the title on the first page of this article, the additional work that must be done can readily be visualized



MR. JACQUES AT WORK ON THE BACKGROUND

In the lower right foreground can be seen the scale model from which the larger group is being erected. In this photograph, too, it is easier to differentiate the painted background from the imitation rocks of the foreground

opening, changes with the position of the observer, and with the distance at which he is viewing the group. The physical difficulties of construction are infinitely greater. In place of the single medium of paint or clay, he must work with a great variety of mediums and materials. While it is theoretically possible to reproduce any outdoor locality, this is not always practical, and the preparator should select such arrangements as can be most successfully shown.

Lighting is important, and correct lighting is much more difficult to secure in a group than in most of its other uses. Shadows of accessories upon the painted background immediately destroy the illusion. The lights should be separated from the group space by dust-proof, but not light-proof divisions, and they must be accessible at all times to permit changing the lamps. The group itself must be dust-proof, though provision should be made to permit entrance if necessary.

There is no place for 'style' or individual technique in background painting, as it must join on to actual accessories in the foreground. The area represented in the background is much greater, and it bears, accordingly, the greater part of the burden of giving the observer the correct impression of the locality represented. If then, a group is scientifically correct, if the specimens shown are prime, and as well done as modern methods per-



AN INCOMPLETE DETAIL OF THE GROUP

The birds themselves—a horned puffin, three kittiwakes, and two tufted puffins—are as they will appear when the group is finally completed. The nests, however, still require some finishing touches

mit, if the composition and arrangement are pleasing, if the habitat is that which is most characteristic of the specimens shown, and if, in addition, we get an impression of light and air, of wind and weather, the group will have approached the fulfillment of its mission.

The American Museum has a large staff of preparators and artists under the direction of Mr. James L. Clark, and a number of habitat groups are now being prepared, each with problems of its own as difficult, or more so, than those of the group described in this article.

We may hope to see in the near future many groups whose standards are higher than anything heretofore attempted.

A MASTERPIECE OF
THE SCULPTOR'S ART



EARLY PERIOD
POTTERY HEAD, TYPE D,
ZACATENCO. ACTUAL SIZE

ON THE THRESHOLD OF NATIVE AMERICAN CIVILIZATION

By GEORGE C. VAILLANT

Assistant Curator of Mexican Archaeology, American Museum

THAT aspect of historical research known as archaeology may be said to begin when man ceases to speak for himself and must be spoken for. In the actual garnering of materials for the history of peoples, archaeology comprises the acquisition of data not contained in libraries or governmental archives. Modern history, as the term is commonly used, describes the economic and political development of peoples. Art, science, and literature are placed in different categories as parallel to but not necessarily unified with, the social unfolding of a nation. This distinction is more a convenience in understanding than a grammatical or a philosophical definition.

The mass of documents contempora-

neous with the events described humanize the past through the depiction of individuals and social groups. Going backward into the ages, through the exigencies of faulty preservation of archives and a natural blurring of detail due to chronological distance, the individual and the political party become obscure and merge in with the civilization, material and spiritual. The shift from the archivist to the archaeologist occurs at this point as an almost imperceptible transition.

The interpretation of the history of Ancient Greece is a good example of the case in point. There is an elaborate political and social history preserved by Roman and Greek commentators, that gives a full and precise story of the fortunes of states, parties, and individuals,



EARLY PERIOD POTTERY

L. to R. 1, trade piece, Red and Orange on White, $\frac{1}{4}$; 2-5, bowl sections White on Red, $\frac{1}{4}$; 6, small bowl, Black, $\frac{1}{4}$

but these accounts do not persist very far back. The material remains of the Greeks are gathered by excavation. Really from Roman times there has gone on a continuous effort to identify the written social histories with the monuments. It becomes gradually evident that the political history does not coincide entirely with the development of culture. As the formal history of Greece dwindles off into the *Iliad* and the *Odyssey*, in the absence of a precise time count the cultural background of the peoples described in the epics rests on the identification of remains as their handiwork.

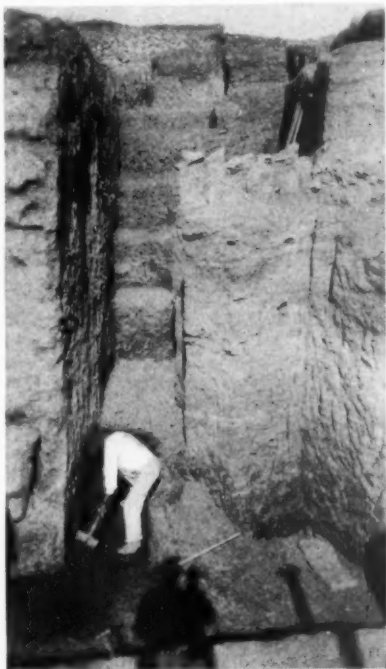
When we begin to consider peoples whose written records have disappeared or who, like the majority of the nations and tribes who have populated this globe, had no writing at all, it is the material culture which we study to try to find the man behind. In contemplating human history as a whole, it is what man has achieved that tells his story long after he has disappeared. Primarily, however, it is the living being and not his handiwork that interests us, and the most difficult task that the archæologist has to

face is the reconciliation of the surviving examples of the handiwork of man, with his vicissitudes and triumphs as a living being.

At the outset, the student of the past suffers the handicap of having to derive his knowledge of a given people from less than a twentieth of their total material possessions. Except in a very excep-

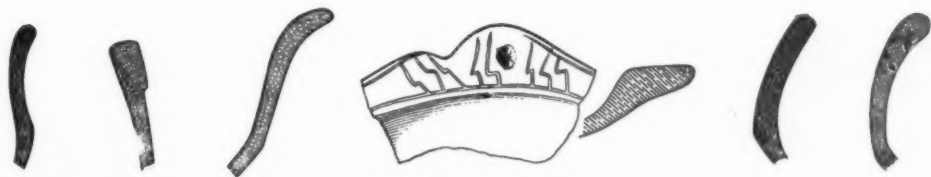
tional case, only relatively imperishable substances like stone, pottery, bone, and, rarely, shell, survive. Naturally the immaterial remains like social organization, mythology, language, philosophy, have disappeared. The tribes of the Northwest Coast whose art as seen in totem poles, chests, and baskets, together with a complicated social structure and a rich mythology, forms an interesting human development, would be completely unknown to us had they disappeared five hundred years ago. Their art is expressed on perishable substances, like wood, which would not have endured for long on the

damp coasts of Alaska and British Columbia. The stone work of these people, which alone would have survived, is in no sense commensurate with their



PEELING THE DÉBRIS

Trench D. The workman is standing on the seventh of the ten cuts made before reaching bottom



EARLY PERIOD POTTERY

Sections of bowl rims. L. to R. 1, Black; 2, 3, Bay Ware; 4, 5, White; 6, 7, Bay ollas. 4, 5 about $\frac{1}{4}$; rest about $\frac{1}{2}$



MIDDLE PERIOD ORNAMENTS

Top row, L. to R.: stalactite ring, jade ear-plug, shell, pottery whistle

Bottom row: pottery ear-plugs, jade pendant, and hemispherical ornament of pottery

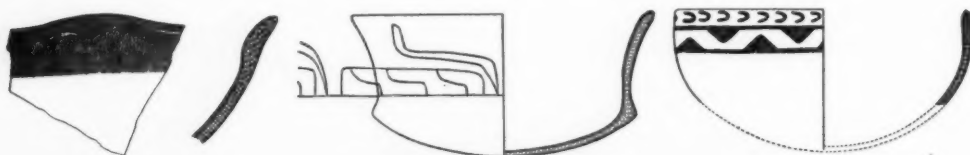
Scale shown in photographs, 10 centimeters or 4 inches

wood carving or their social organization. The Basket Makers, the first race to occupy Arizona, dwelt, however, in dry caves. This choice of habitation, coupled with the aridity of the region, preserved their remains. They made some stone tools, had not invented pottery, and had just crossed the threshold of agriculture. They had, however, a great skill at weaving from yucca and Apocynum fiber, baskets, nets, waterproof woven bottles, sandals, and many other things. Had they lived in the open, all these possessions would have disappeared, and an interpretation of what survived would show them to be much less developed than was really the case. One wonders in this connection whether the people of the European Upper Palæolithic were not much more advanced than their stone work indicates them to be.

The archaeologist in his reconstruction of history must then, primarily, discover a sequence of events and some sort of a chronology; secondly, he must try to

interpret the remains encountered by him to throw some light on the social and political life of their makers; and thirdly, from these remains he must attempt to appraise the extent of their perishable possessions. Archaeology, briefly, becomes in practice a sort of algebra, where formulæ are sought for the equation of man's total development with his remains. Bearing this conception in mind, the apparent puttering of the archaeologist with stocks and stones becomes dignified into an arduous means to a very worthy end.

The perfect formula has not been devised. The most serviceable medium developed to date is pottery. Among most primitive people it is a household art like cooking or weaving. It is, therefore, strongly subject to the control of communal custom. At the same time it can perform its functions without being subject to rigid controls of form like a stone tool. Hence, fashions in shape and decoration can be readily expressed



MIDDLE PERIOD POTTERY

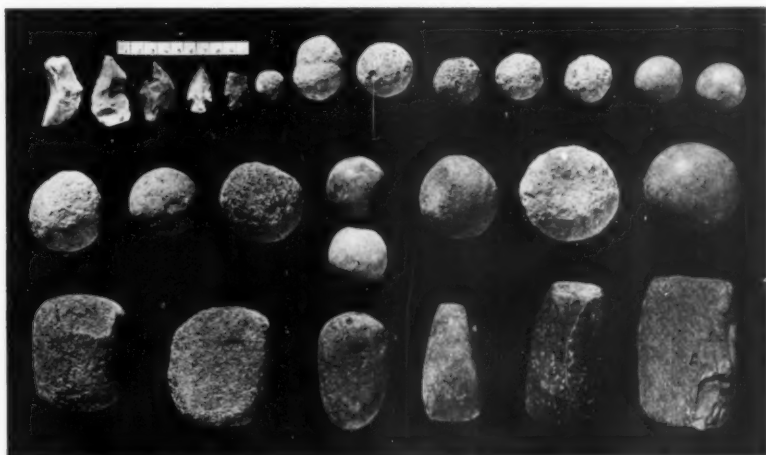
1, 2, incised Red on White; 3, incised Black; 4, Red on White. About $\frac{1}{16}$

LATE AND
MIDDLE PERIODS
Stone Implements

Top row: knives,
arrowheads, small
sling stones

Middle row: sling
stones of lava,
quartz, marble

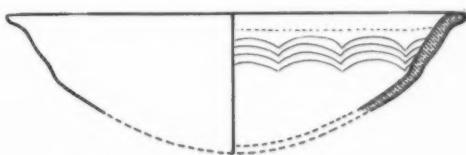
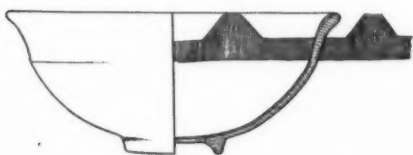
Bottom row: pestles
of lava; nos. 4 and
5, jade axes



on pottery, so that one may see rigidly local styles changing with the years. Furthermore, a well made pottery vessel is a desirable article of trade. When a pot is broken, the fragments are virtually indestructible, and by studying the sequence of their types in rubbish heaps one may in this way erect a chronology. This conservatism in adhering to local styles defines a tribe and its movements, while stray pieces from other localities indicate trade relationships. At the same time these trade pieces by their position in a site of known stylistic succession give a basis for a future sequence in their site of origin. As deeply stratified archaeological sites are rare, the value of dating single occupation sites by the position of their traded sherds in a locality where such a chronology exists, is readily appreciable. Furthermore, temples and pyramids may be arranged in chronological series, by the potsherds found in the adjacent débris.

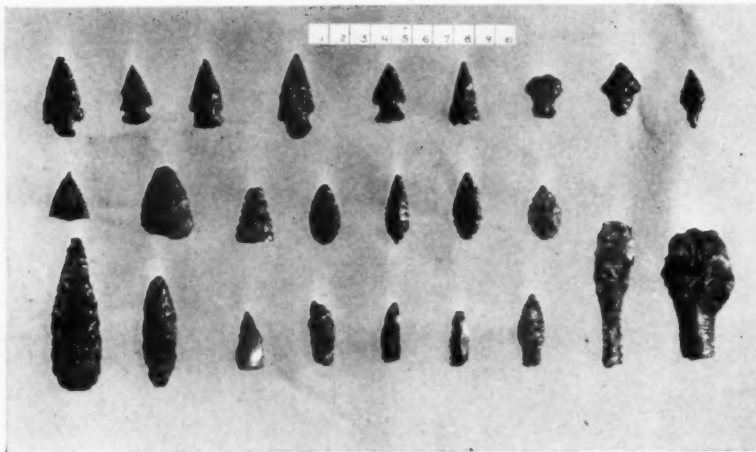
The work of the division of anthropol-

ogy of the American Museum in the Valley of Mexico the last two winters serves as an illustration of the values and the limitations of archaeological method. Broadly speaking, three civilizations, or cultures, are known in the Valley of Mexico: that of the Aztecs who were living there at the time of the Conquest by the Spaniards; that of the Toltecs who built the famous Pyramids of San Juan Teotihuacan; and finally, a very much cruder civilization, of whose makers there is no record. Objects of this last culture have been found in river gravels overlaid successively first by Toltec and then by Aztec remains. Somewhat similar material occurs under a thick flow of lava to the south of Mexico City, in one case, at Copilco in the débris of a camp site, wherein also are found burials, and in another, at Cuicuilco, associated with a huge pyramid of adobe, around which the lava flowed, sealing in the contemporary detritus, as well as covering the lower slopes of the pyramid. Thus, the history



MIDDLE PERIOD POTTERY

1. Red on Yellow. 2. incised Black. About $\frac{1}{4}$



CHIPPED
IMPLEMENTS
OF OBSIDIAN

Top row mainly
Late Period;
second and third
rows, Middle and
Early Periods

of the material culture of the Valley from the coming of the Spaniards to the remote past is expressed by three groups of remains: Aztec, Toltec, and the cruder material of earliest date.

From Spanish accounts, from codices, and from the writings of native historians a generation after the Conquest, a social history has been composed for the Aztecs, in which the varied tribal histories of what we know to have been many groups, have been welded into the synthetic evolution of a single group. This account carries us to about the twelfth century after Christ. There is a scattering legendary mention of the Toltecs as having an empire of which, after it fell about the tenth century, more or less isolated elements survived until the infiltration of Aztec tribes. Yet these Toltecs have no very definite history; and the pyramids, sculptures, and pottery assigned to them with every probability of correctness, are not classified to reflect an historical development. The student

finds preserved for him, as it were, a static civilization. Similarly the cultures called "Archaic" are dismissed thus, in a name, with some figurines classified as transitional between them and Toltec.

On examining the remains of pottery and figurines from the earlier cultures, it was evident that there were several different types of figurines, so distinct that they could not have been contemporaneous, or, if made at the same time, must have been the product of several local cultures. The figures found in the excavation at Cuicuilco, the pyramid under the lava, were quite unlike those found at Copilco, the camp site covered over by the same volcanic flow. The pottery likewise fell into at least two styles.

Doctor Clark Wissler, chief of the division of anthropology, and Mr. C. L. Hay, a Trustee of the Museum and Research Associate in Middle American Archaeology, decided to undertake a series of excavations to expand the chronological sequence of the cultures



MIDDLE PERIOD POTTERY

1, 2, Black Ware like Copilco, about 14; 3-6, Bay olla neck sections. About 14

ANTLER TOOLS

Top row, chisels for
graining hides and
flaking obsidian;
awls.

Bottom row, pest-
les and picks



of the Valley of Mexico, and to supplement the splendid work of the department of archæology of the Mexican Government in its preservation and uncovering of the major ruins. The Museum proposed to make stratigraphic studies in rubbish heaps, and by segregating the pottery types found at different levels, make a chronological and ethnological skeleton to aid the broader elucidation of Mexico's past, which the Mexican Government was ably carrying on.

Doctor Wissler and Mr. Hay chose the earliest remains as a point of departure to find the sources of the subsequent Toltec and Aztec civilizations. Mr. Hay, a student of Valley of Mexico problems and an authority on the early cultures, graciously supported the work and collaborated in its execution. To the writer fell the details of excavation.

After a season's inspection of sites containing early culture material, a deep bed of débris was chosen, which lay on the outskirts of Zacatenco, a hamlet

just north of Guadalupe Hidalgo, a suburb of Mexico City. Trenches were sunk immediately to find bed rock or the undisturbed soil. Once bottom was discovered, the trenches were extended to cross section the mound. Objects were carefully recorded as to their source of provenience, and maps which followed the daily progress of the work in plan and in section, controlled still further the cataloguing. A small gang of six men was trained to dig carefully, and a judicious system of bonuses whetted the sharpness of their eyes. The handling of the excavated earth was a problem; but by means of scaffolds the men were able to remove it far enough not to interfere with their work. Since the deepest cut was about twenty-five feet deep and the most of the digging was between twelve and fifteen, successive layers were removed. The trenches drifted in against a vertical face, and the strata were thereby visible on three sides of the trenches. The results were not



LATE PERIOD POTTERY

1-5 Bay olla necks; 6, leg of Red on White bowl; 7, 8, bowl incised Red on Yellow; 9, leg, Brown. 1-5 about $\frac{1}{8}$. 6-9 about $\frac{1}{4}$



FIGURINES

Early Period.
Type C. Note
development of
features by fillets
of clay.

Top rows Zaca-
tenco.

Bottom row, other
sites in Valley of
Mexico; 3rd
figure, Azca-
potzalco gravels

immediately visible; three months of study and interpretation of material after excavation had ended brought the following facts to light.

The site of Zacatenco lay on the southeast slope of a rocky peninsula that extended into a lake. The southerly exposure ensured warmth; the almost complete surrounding of the knoll by water was a protection against enemies; the lake itself yielded a valuable part of the food supply in the fish and ducks that frequented it. The presence of grinders and grinding stones indicated the growing of grain, undoubtedly corn, and the quantity of fragments of storage vessels shows that it must have been the staple food, for there would be no need to store water on the borders of a lake. The presence of deer bones shows that the chase also added variety to the larder. Thus, in every way the locale was favorable for occupation.

As time went on, an enormous accumulation of debris was formed from piles of corn husks, adobe washed from the houses, and the soil that the heavy showers of the rainy seasons was constantly eroding from the hill. We find low revetments of stone laid up to hold these loose accumulations in place and to provide level spaces on which to build

houses. Finally, owing to the softness of the dirt underfoot and perhaps because of a rise in level of the lake, the people moved from the gently sloping glacis of rock at the foot of the hill on to a low cliff. We find a repetition of conditions, for debris accumulated against the ledge of rock. The occupants moved down hill as the rubbish leveled off the contours of the slope. There was a constant use of retaining walls to prevent the formation of gullies, during the rains, which would undermine living surfaces and wash away houses.

Finally, so much dirt and rubbish accumulated at the foot of the hill that the slopes became gradual. The occupants then moved out on these surfaces which had covered completely the original contours of the hill. By studying these occupations in the manner described we find three quite clear phases of occupation, Early, Middle, and Late.

The Zacatenqueños had no knowledge of metals. But lava, obsidian, and quartz were excellent substances for the fashioning of tools. From lava they made quadrangular metates bordered on their long axes by ridged sides and supported on three stubby legs. Manos or grinders for use in connection with them were like a triangle in cross section and the

long sides of the triangle formed the grinding surface. This perfect serviceability brought no need for change with the lapse of time. In the second period of occupation lava was further employed in the making of small spheres possibly for use in games but more probably for missiles for a sling.

Obsidian, or volcanic glass, was made into implements by two main processes, flaking and chipping. The flakes were struck off from a conical core and received little further treatment. They must have been used as razors, or knives for fine cutting. The chipped tools seem to have been made from breaking up the core after it was too small to yield flakes. The pieces were chipped into projectile points. In the early level the shapes were simple but later on in the upper cuts tangs were added and the chipping became more even.

Quartz was used little in the Early Period, only cores and spalls occurring, but in the Middle Period it was fashioned into well polished balls, by what must have been an exceedingly laborious process. These spheres were perhaps for use in slings though it is difficult to conceive of such well finished specimens being put to so plebeian a use. In the Late Period use of quartz was less frequent.

Other stones occurring in the excavations are granite, marble, diobase, and sandstone. The first two were used in making the missiles just described.

The Zacatenqueños of the Middle Period traded to some extent, for we have in jade, two axes, a pendant, and a part of a lip- or ear-plug. This is the earliest recorded occurrence of jade in an archaeological site in Mexico.

It is obvious that the Zacatenqueños had at the outset a fair mastery of stone manufacture, but that the simplicity of the forms which are at the same time perfectly serviceable, is not capable of reflecting very much the passage of time. Bodkins, needles, and awls of bone show the same changeless quality. Antlers were fashioned into chisels, into tools for flaking stone by pressure, or utilized as handy instruments wherever a point or a blunt end was required. The inflexibility of the material, together with the unchanging nature of their function, makes them poor guides of development. For arrival at a certain degree of culture all people must sew leather, weave baskets, or make tools.

Shell is perishable and rarely preserved. We did find one or two fragments that might have been ornaments. The figurines are adorned with amulets, necklaces,

FIGURINES

Early Period. Type D. Note finesse in execution.

Top row, Zacatenco. Bottom row, other sites Valley of Mexico. 4th figure, Azcapotzalco gravels



and ear-plugs. But our excavations yielded almost no examples of these save for a ring and a bead of stalactite, and the few other trinkets described. Presumably the ornaments were of shell and disintegrated in the humid earth during the lapse of centuries. For the same reason apart from flakes of charcoal no trace remains of the use of woods for tools or sculpture. House types are likewise unknown to us. The great mass of adobe in the soil suggests simple dwellings of wattle and daub.

The textile art also has left almost no remains. A tiny worn fragment, by a freak of nature, was preserved in the rot of a child's brain, whose skeleton had disintegrated into the consistency of cheese. Two perforated discs of clay and one of sandstone are probably early forms of spindle whorls. A cast of the base of a coil-weave basket gives a tangible basis for the usually incontrovertible assumption of the existence of basketry. A whitish coating on the sides of one or two graves indicates perhaps the use of mats or perhaps blankets of bast. The figurines from the earliest period wear elaborate turbans which could only have been made of textiles, and some few specimens wear little skirts. What other clothing they wore

is problematical. The depiction of clothing is so great an obstacle to the sculptor that even now our æsthetic tends to demand as an ideal, nude rather than draped figures. Hence we cannot expect to tell much about the clothing from the sculpture, but it might be remembered that the climate of Mexico is temperate.

Pottery is found in the greatest profusion, literally by the cart load.¹ Over ninety per cent of the vessels are for storage, cooking, and similar humble uses. They are made of a coarsely kneaded clay that burns, when fired, to a reddish-brown, approximating a bay color. The shapes are ollas, deep pots for the storage of grains and liquids, and large wide-mouthed bowls presumably also for storage. The vessels are perfectly adapted to their purpose. There is no decoration. Changes, therefore, are not violent. In the Early Period the neck of the olla is not treated as a particularly distinct unit. There is a flat inward curve from the mouth out into the fullness of the body of the pot. In the Middle Period one observes a tendency to make the body more globular, until in the Late Period we find the ves-

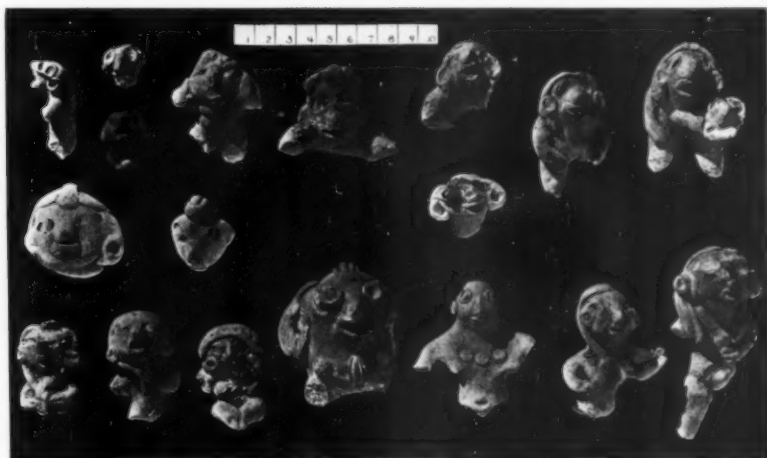
¹Only two whole pots were recovered. The vessels illustrated in this article are reconstructed from sherds.



FIGURINES

Middle Period
Type B. Note stylization.
Top rows, Zacatenco.
Bottom row, 1, Copilco; rest mainly Zacatenco

FIGURINES
Middle Period
Type F. Observe
crudeness.
Toprow, Zacatenco.
Note Madonna, last
on right.
Bottom row, other
sites in Valley



sels predominantly globular in shape with the necks well defined by flaring outward from the body, by being reinforced into a thick curved lip, or by having straight necks surmounted by a flat lip. The bowls or cajetes suffer almost no change, but in the Late Period for some reason the manufacture stops.

A number of wares might be classified as for the service of food, such as small vessels convenient for holding the noon-day meal. In the Early Period we find a thick black clay formed into bowls, a chalky white ware into shallow dishes, and a red ware, simply ornamented with geometric patterns in white paint and fashioned in more or less straight-sided bowls with rounded bottoms. Throughout the period we see that the black ware becomes increasingly fine and decoration enters by the incising of vague meanders on the walls of the vessels. Red paint and incision embellish the white ware which gradually supplants the red ware painted in white. Sophistication of ornament is absent. The decorative sense is latent to the point of non-existence. As a surprise we find traded in from some more advanced neighbor, a white vessel with designs in red and orange.

In the Middle Period the practice of

decorating the white vessels with red paint disappears about half way through the deposit. The incised black ware still progresses technically, and as decoration, besides incisions of the walls, the bottoms are occasionally stippled by tiny gouges. New forms appear like gourd-shaped vessels and shallow dishes with handles supported on high ring bases. Bowls of cream-colored ware with no decoration, and ollas of a thin granular white ware decorated crudely in maroon, supplant the white wares of the Early Period. A yellow flaky ware is formed into bowls on a low ring base decorated with stripes of red paint. Trade is seen in the presence of hard, well fired, orange ware, and of another the slip of which is so much harder than the body paste that it is well described under the name Orange Lacquer. With the exception of the trade wares, the pottery is homologous with the pottery of Copilco, under the lava, but Copilco, lacking development of white pottery adorned by red paint, is probably coeval with the latter half of this Middle Period.

At the same time the people began to make balls of pottery, which might be for slings in spite of their friability. We find one or two ear-plugs and fragments of gorgets representing pathetic attempts



FIGURINES

Middle Period
Type A. Like Type
B. Common under
lava at Copilco.
Top rows mainly
Zacatenco.
Bottom row, other
sites in Valley.
Note bird headress
on number 2 of
bottom row

at adornment. Whistles, sometimes adorned with animal heads, also occur. Ladles and pottery rattles fill out our list still further. Potsherds are rubbed into circular shape for a presumable employment in games of chance.

In the Late Period these service wares all disappear. The principal ware is a yellow-brown pottery with heavy, solid, triangular and stepped patterns in thick red paint. Sometimes the designs are outlined by incision. More developed but still unsophisticated patterns are outlined by white paint in the case of somewhat better made bowls. This is the first appearance of polychrome decoration. The shapes are shallow dishes resting on a hollow tripod support with a flat, slightly thickened rim. Another distinctive type comprises deep bowls with the traditional Early Period format of bottom and wall elements. The bottom is expanded now, however, and the side contracted into an ornate rim which is covered with a highly polished red paint. This same shape is seen in a ware varying from chocolate to brown. Sometimes in this case the rim is simplified into a sharp incurve. The tripod support is common. Eccentric and ornate shapes obtain more frequently than in the preceding periods. The elements of

hollow tripod supports, of polychrome decoration, of reduction of the walls of bowls to rims, together with the development of the necks of ollas, constitute in tendency an approximation to the finds at the lava-buried pyramid of Cuicuilco. But morphologically the two ceramics are not identical.

We see in the pottery of Zacatenco, wares that are distinctly associated with different periods. We gather the impression of a conservative people whose ideals seldom in practical life passed beyond the utilitarian. Not until the last period, in spite of trade relationships, did they seem to accumulate ideas from other sources, when they altered completely the shapes of this service pottery, and even began to make a few halting steps toward a decorative art.

Against this drab and comfortless background of daily necessities treated with unrelieved practicality, we find an amazing diversity of treatment and vitality of expression in the little clay figurines. Presumably they are associated with the practice of some cult. This variability seems to preclude the representation of a divinity clearly defined into attributes. Yet, considering the cultural level of the people, they are too well made to be toys. They are ubiqui-

tous, being found in fields and in rubbish heaps rather than being confined to some tomb or shrine. They are distinctly anthropomorphic, showing as they do a range of individual costume, and positions varying from an erect posture to a seated mother nursing a child. Two types are found in the Early Period. The chief, Type C, comprises slim-waisted figures, usually erect, with pointed faces the features of which are indicated by fillets of clay. Details of dress and adornment are indicated in the same manner, like the folds of a turban, a bird headdress, or a bead necklace. Contemporaneous with these are very much more sophisticated examples, Type D, of which the elements expressing the features are smoothed down into the unit-mass of the head. Their casts of countenance are brought out with a care almost meticulous. The bodies of this latter type do not differ from the former. Some sporadic examples not classifiable into the preceding categories comprise dogs, snakes, and monkeys which are modelled with some realism. Types C and D are widely distributed in the Valley of Mexico. C is almost, and D completely, absent at Copilco, but they both occur in the Azcapotzalco River gravels.

The Middle Period deposits contain

three types different in style from the preceding. A flat-faced type, B, meant to be seen only from the front, has some diversity of pose and seems to develop out of Type C. The execution is carried out in a hasty slap-dash manner. Contrasting strongly with this class is Type A, which probably gives us the best idea of the look of the people inhabiting the Valley at that time. The fleshy contours of the face receive careful attention, and to soften the lines about the face and mouth, a space is gouged out and in it are laid a roll of clay for the nose, and two for the lips. The modelling of the limbs and torso is coarse. Contemporaneous at Zacatenco with Types A and B, is the gross and crude type F. The figurines are hardly distinguishable as human beings, but the repeated occurrence of the same style shows it to be a conscious manner of expressing the human or humanly divine form. It is difficult to say whether the appeal of Type D shows superior artistic skill to Type A wherein there is a definite attempt to solve problems in the depiction of the human face. We notice, though, that the figurines of the Middle Period are much more stylized than the varied representations grouped as Types C and D. Types A and B pre-

FIGURINES

Late Period Type E. Observe the degeneration of the plastic.

Top rows, Zacatenco.

Bottom row, chiefly other sites in Valley of Mexico



dominate at Copilco so that their presence, coupled with the pottery, shows a definite contemporaneity with Zacatenco. But Type A must have been conceived and developed outside of the Valley, as there have been discovered no transitions between it and the other examples.

The last occupation shows a predominating type, E, that is inferior to the plastic preceding it and also technically to the pottery associated with it. An examination of the technique shows the hasty execution of a strongly conventionalized type. Associated with Type E are many other styles of sculpture in clay. In some of the specimens there is an improvement in paste and finish over the earlier styles, but in actual representation of the human form most are inferior. The majority of these other groups, which are broadly grouped under the succession of letters from G to M, are too rare to be anything else than trade specimens. From their occurrence in other sites like the Pyramid under the lava at Cuicuilco, we may assume them to be traded pieces or perhaps examples of types from an ultimate surface of occupation at Zacatenco, that has eroded since the abandonment of the site. The Late Period at Zacatenco must be, therefore, anterior to Cuicuilco.

Perhaps, as Professor Kroeber thinks, in these little figurines, growing more conventionalized through the ages, we may discern a growth toward a for-

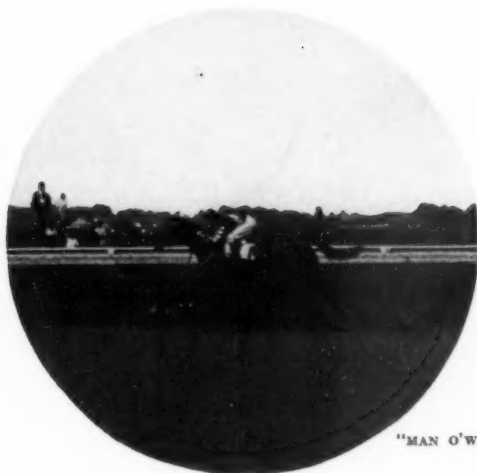
malized religion that culminates for these early periods in the pyramid at Cuicuilco, and later expands into the elaborate theological arts of the Toltecs and the Aztecs. We have seen how, as in the case of these Zacatenqueños, a well balanced material culture does not lead necessarily to an art, and it is probably true that the distinctly artistic manifestations in Mexico followed in the train and under the stimulation of the growth of religion and priesthood.

Thus we observe in the interpretations of these broken fragments the beginning of a history. The aim of this survey in its next season's work is to extend the Zacatenco sequence up to the time of the Toltecs and later to the Aztec period. Speculation is futile as to the absolute age of the lava flow and the cultures beneath it, until we have a continuous building of cultural development, divided off into the floors of consecutive typology. With this as a basis, we can extend our studies south until connection with the Maya and their calendar based on the absolute recording of time, will render possible the resolution of our history into dates. During this research we have to face changes in archaeological thought, interpretation, and method. Archaeology is still in its infancy, but when it reaches an adult stage, we may expect a wider and a truer conception of man in the fuller perception of his past.



LATE PERIOD POTTERY

1 and 4 polished Red bowls; 2,3 polychrome bowl, Red and White on Yellow decorated inside and out. 1 about $\frac{1}{4}$; 2, 3, 4, about $\frac{1}{8}$



"MAN O'WAR"

HOW ANIMALS RUN

Some Interesting Laws Governing Animal Locomotion, and an American Museum Exhibit That Illustrates How Certain Bones Function During Speedy Action.

By S. HARMSTED CHUBB

Associate Curator of Comparative Anatomy, American Museum

ILLUSTRATED WITH PHOTOGRAPHS BY THE AUTHOR

SINCE the beginning of osteological work, exhibits of mounted skeletons in museums and elsewhere have been objects of questionable interest even to specialists who might wish to examine and compare individual bones. But for the student who would like to be informed as to the presence or absence of clavicles, vestigial fibulae and digits, sesamoids, certain teeth which are slowly becoming extinct, the presence and arrangement of hyoid bones and ear ossicles, or other anatomical structures, such exhibits were useless or misleading. All of those minute details, which are of paramount importance, were considered by preparators to be quite unessential or were not considered at all, being entirely overlooked and lost during preparation, while proportions were incorrectly represented and bones were made to assume positions that would be impossible in the living creatures.

It would never have occurred to the artist, desirous of studying the bony framework of man or horse so that he

might the more truthfully portray his subject in sculpture or on canvas, to visit a museum of natural history in his quest for the truths to which bones might be expected to testify, for the skeletons to be found there had little suggestion of the form of the living creature in which they once made animation possible.

Neither had it occurred to the preparators that these "dry bones," as they are often, but unjustly, called, could be placed in positions which they had constantly assumed in life, and thus express beautiful movements, animation, and even mental emotions, so that not only the student and artist but the casual museum visitor would discover beauty in them. It was small wonder that the department of skeletons was considered a place to be shunned by those of refined tastes.

Dr. E. W. Gudger of the American Museum has published a very interesting paper in *Annals of Medical History* for May, 1929, entitled "Some Early and Late Illustrations of Comparative Os-



RUSSIAN WOLFHOUND

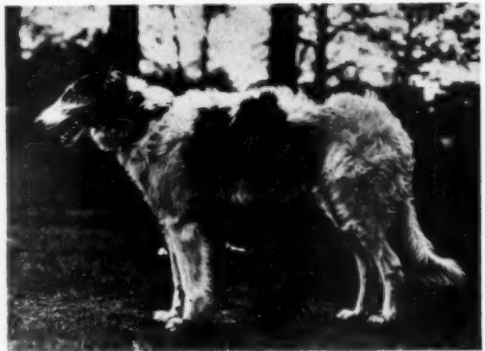
In the "flexed" phase of the stride. This photograph shows clearly how, in this position, the hind legs pass on the outside of the front ones. The dog is "Cerebro of Romanoff," owned by Louis J. Murr. Compare with running bulldog on page 545

teology" which describes in a most able and graphic manner some of the advances in osteological work from early days.

At the American Museum an earnest effort is being made to create what might be called a hall of "living skeletons" where the young student, the comparative anatomist, and the artist may come to study and find help. It is with great satisfaction, therefore, that we see, almost daily, students seated in our hall diligently sketching these skeletons.

In this hall there is a collection of specimens, most of which are members of the Equidæ or horse family. These subjects have been prepared and mounted to show the action characteristic of different breeds or types of animals. "Sysonby," one of America's famous race horses, and "Lee Axworthy," the world's champion trotting stallion, form a part of this distinguished assembly.

The latest addition to this exhibit is the skeleton of a Russian wolfhound, represented as running as if his life, or the safety of his master's flocks, depended upon the immediate capture of a marauding wolf. In earlier days on the Russian



RUSSIAN WOLFHOUND "BORIS"

Hounds, as a group, are the fastest of dogs, and while it cannot be said that Russian wolfhounds are the fastest of the lot, they are wonderful running animals. Owned by Charam Kazanjian



ENGLISH BULLDOG

"Suncrest" owned by Percy Maude, in a position corresponding to that of the running wolfhound on page 544. Though the bulldog finds it difficult to follow the rules of the race and pass his hind legs outside his front ones as he runs, this picture plainly shows that he insists upon doing so

pasture lands, the ancestors of these dogs were trained to protect the defenceless flocks and herds from depredations by hungry packs. There are few animals of its size which can acquire greater speed than the wolfhound. Even the race horse

only slightly exceeds the speed of this fast running dog.

The preparation of this specimen is based upon anatomical study, careful observations of living animals on the race track, and a great many photographs of animals running at high speed. These pictures were taken with an exposure of $1/1000$ of a second in order to record the exact position of every part of the subject during this extremely rapid action.

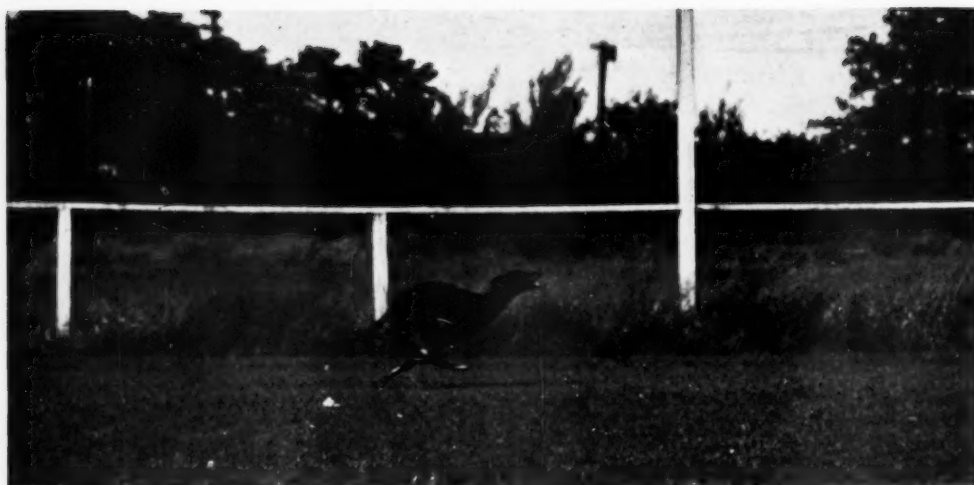
The object of this exhibit is not only to show the function and behavior of the bones during an intensely speedy action, but also to point out certain interesting rules and regulations which are strictly adhered to by nearly all terrestrial mammals. Even animals so totally different as the dog, horse, cow, or pig, all follow similar rules in the progressive movement.

The moment in the stride which has been selected for mounting the wolf-



"SUNCREST"

This picture plainly shows how much farther apart are the bulldog's front legs than are his hind ones. Despite this fact the hind ones are spread, in running, to take the outside place

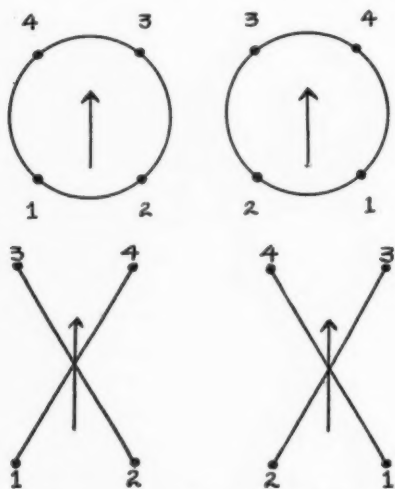


THE RACING GREYHOUND "BLACKIE"

This photograph was taken at the moment of maximum flexure with all four feet off the ground. This animal has run one quarter mile in 26 seconds—a speed of 34.61 miles per hour. "Blackie" is owned by L. I. DeWinter

hound skeleton is approximately the same as that chosen for the race horse, "Sysonby," which is in an adjoining case.

Most mammals have three natural gaits, the walk, the trot, and the run.



HOW DOGS AND HORSES RUN

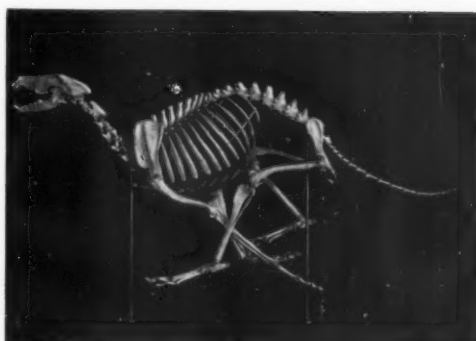
The upper half of this diagram illustrates the rotary action of a dog's feet as he runs. The feet move in the order of the numbers, and although the action may be in one direction or the other, it is always as shown by one circle or the other. The lower half of the diagram shows the diagonal action of the horse's leg movements

These respective methods of locomotion vary so slightly in different animals that it will be interesting to point out some of the minor differences. The dog, a much smaller animal yet almost equalling the speed of the horse when running, must necessarily acquire a much more extreme action than does the latter, but the differences are mostly matters of degree. For instance, at the moment when the limbs are drawn together the spine of the horse is slightly arched. Compare this with the very strongly curved back of the dog. And, while the hind toe of the horse comes in line with the pastern of the front foot, the limbs of the dog cross almost at the knee of the hind leg and the elbow of the front. It is also found that when the horse is under full speed he is entirely free from contact with the ground approximately one-fourth of the time, that being the moment when the limbs are drawn together, while the dog is suspended in air about one-half of the time, being free from the ground twice during each complete stride, once when the limbs are drawn together under the body and again during the extended position.

There is but one technical difference between the running action of the horse and that of the dog, that of the succession of footfalls. Let us compare the action represented by these two skeletons. In each case, the next foot to strike will be the left hind foot and then the right hind, but the horse will follow the right hind foot with the left front, and then the right front foot. Hence it may be called the diagonal run.

The dog, on the other hand, prefers the rotatory run, striking the right front foot after the right hind, and so on around as shown in the diagram (page 546), so that at the moment when the limbs are drawn together under the body the two which come most nearly in contact with each other are those of the same side, while with the horse they are of opposite sides. As shown in the diagram, the succession of footfalls may be reversed.

Again it must be borne in mind that, while our diagram arbitrarily begins the stride with the hind foot, the animal may fall into this succession on any foot, as he breaks from a slower gait or starts off with a sudden spring.



A MOUNTED SKELETON OF A RUSSIAN WOLFHOUND

The movement in the stride which has been selected for mounting is approximately the same as that chosen for the skeleton of the race horse "Sysonby," pictured on page 551

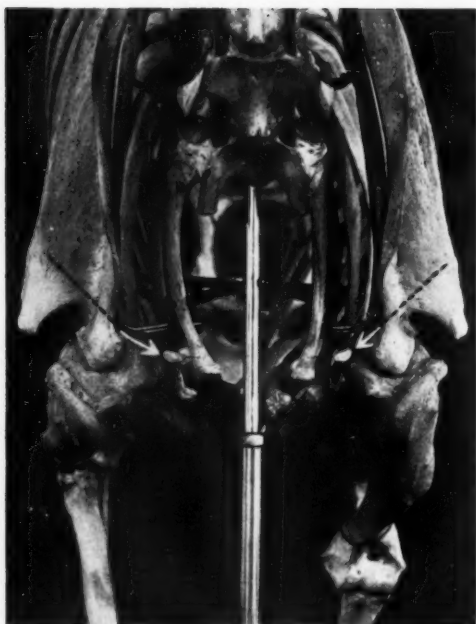
While the respective members of the Equidæ family, also the cow, buffalo, goat, bear, and others employ the diagonal run, some of the ruminants, or cud-chewing animals, such as the deer, elk, and antelope, adhere to the rotatory system of the dog.

To explain more clearly the running action of the horse two interesting photographs of the great race horse, "Man o'



GREYHOUND "GIRLEY" IN THE EXTENDED POSITION

The position in which the dog is shown appears to be almost identical with the position of the race horse "Man o'War" shown in the picture at the head of this article. Despite this apparent parallel, however, the succession of footfalls of the two animals is different as is explained by the diagram on the opposite page. "Girley" is owned by Mrs. Alfred W. Seeler



FRONT VIEW OF THE WOLFHOUND
SKELETON

In these highly specialized running animals many changes have naturally taken place. The arrows, for instance, point to the vestigial clavicles which, because they are no longer useful, are slowly disappearing

War," are shown, one in the extended position with two feet on the ground and the other in the flexed phase of the stride with all four feet high in the air.

One of the laws of progressive movement which all running mammals seem obliged to obey is the manner in which front and hind feet pass each other during the moment of maximum flexure. As the hind feet reach forward for another spring, they always pass, not toward the median line, but outside of the front feet. This interesting fact is nicely demonstrated when we walk out after a fresh fall of snow and examine carefully the tracks of a rabbit, squirrel, or mouse, and on these occasions we may also read the written answers to many of Nature's secrets.

But for one question we do not seem to find a satisfactory answer either in the freshly fallen snow or the tide-washed

sand, and that is: Why is it so imperative that a creature must pass his hind foot in a course lateral to his front foot?

There is one very striking example of the universal application of this law which has come to my notice. The English bulldog, poor creature, has been so distorted by man's breeding and selection that he can hardly be called a normal animal. His measurement through the shoulders is two or three times that of the hips, and as he stands, the distance between his front feet bears a similar proportion to that of the hind, so that we might suppose it to be quite impossible for him to reverse the measurement between front and hind feet in any position that he assumes. Yet, when he can be induced to run with sufficient speed to bring his hind feet in any proximity to his front feet, he follows the well established and time honored traditions of his ancestors, passing his hind feet outside of his front—a most interesting example of the way that exacting old "Dame Nature" demands observance of certain rules which might seem to us quite arbitrary.

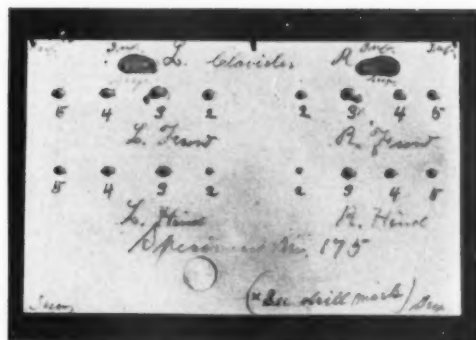
From an anatomical point of view the wolfhound skeleton shows several interesting features. In many animals the clavicle or collar-bone is an important and highly functional organ, particularly in man, where it is well developed, while in most of the large mammals it is entirely extinct, there being no bone connection between the body and the fore legs. The weight of the animal's fore quarters instead is suspended by muscles and tendons between two pillars formed by the leg bones and shoulder blades.

In the dogs, as is the case with most of the carnivorous animals, the clavicle seems to be in a transitional stage, being very small and quite without function. It has no direct connection with the rest of the skeleton but is simply lodged among the muscles of the shoulder and was, no

doubt, functional in some remote ancestral form but is now as useless, though not so mischievous, as the human appendix. We have reason to expect that this small vestige, handed down from the remote past, will, in ages to come, be entirely eliminated from the dog's anatomy.

While these clavicles are in the last stages of a slow decline, there is another set of bones shown in the wolfhound skeleton which must be placed in a very different category, as they are now in their early infancy, and may be regarded as modern improvements,—of course, using the word modern in a comparative sense. These bones, owing to the nature of their development, must be classed as sesamoids. Dogs and their wild relatives are particularly well provided with these small bones, having from sixty-two to seventy-eight located on the feet and legs.

The largest and most highly developed sesamoid in the animal system is the patella or kneecap, which is present in nearly all mammals. But the smaller sesamoids vary considerably in number in



RUDIMENTARY SESAMOIDS AND VESTIGIAL CLAVICLES OF THE WOLFHOUND

These small bones, because of their size, are generally overlooked. The sesamoids, however, are highly important parts of the mechanics of running. They are shown fastened on a card where they have been placed in order to prevent their loss while the skeleton is being mounted

different species and a slight irregularity may be observed even among different individuals of a species. These bones always occur near a joint where much violent action is required and are formed in a tendon which has strenuous work to perform, thus reducing friction and increasing power.

As human anatomy was studied before any serious attention was given to the structure of the lower animals, the term sesamoid was first applied to bones of this character which occur in the human hand and foot, and which in size and shape slightly suggest a grain of wheat. But as the knowledge of general anatomy has increased, we find that some of the bones of this class might more properly be compared with "a grain of mustard seed," while others would be more comparable to a horse-chestnut or even a very large-sized potato.

The particular sesamoid bones here to be considered are of special interest because of the fact that they are not generally known, although some of them were figured by De Blainville as long ago as 1839. They are, no doubt, of comparatively recent origin, having been developed as a part of the speed mechan-



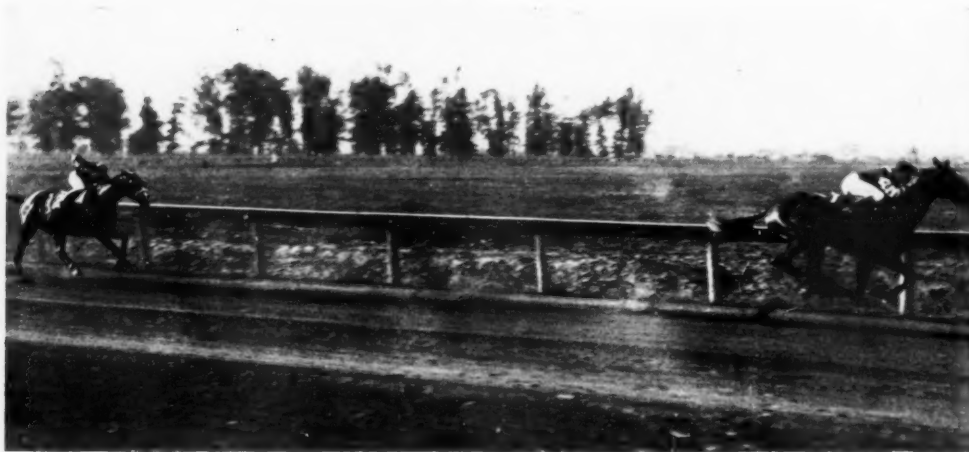
THE BONES OF THE WOLFHOUND'S FOOT

The four arrows point to the sesamoids, which are rudimentary bones within tendons. In dogs, these bones have probably been developed in comparatively recent geological time, and they seem destined to continue their development. The human kneecap is an example of a highly developed sesamoid

ism in the course of the evolution of these fast running animals, as the wild ancestors of our domestic dogs pursued their prey.

They are to be found at the ends of the metacarpal and metatarsal bones of the feet on the dorsal surface. Being very

on the end of a very fine wire and held in the position they occupied in life. Likewise the sixteen rudimentary sesamoids were safely attached to their respective places on the feet near the first joints of the toes.



Wide World Photograph

"MAN O'WAR" LEADING "SIR BARTON" BY EIGHT LENGTHS

"Man o'War" appears in the flexed position of his stride with all four feet high in the air. "Sir Barton's" position is intermediate, and he is shown coming into a position which is the opposite extreme of that in which the camera caught "Man o'War." This photograph was taken during "Man o'War's" last race, at Windsor, Ontario, October 12, 1920

small, ranging from 1 to 3 mm. in diameter, it is not surprising that they have been so generally overlooked in the dissection and study of these animals.

In the preparation of the present wolfhound specimen this set of sixteen bones was very carefully worked out of the surrounding tendons, then pasted on a card together with the precious clavicles, where they were labeled and numbered for safe keeping, awaiting a convenient time for placing them in proper position.

After much time-consuming labor in the general preparation of the bones, the study of animal action to be applied to those bones, the devising and construction of mechanical means to hold every bone permanently in the desired position, and the removal of many temporary accessories, the mounting of the skeleton was nearly complete. Then the clavicles were taken from the card and suspended

There is still another set of sesamoid bones which frequently occur at the second joint of the toes, but these are extremely small and quite irregular and were found absent in this specimen.

In the first paragraph of this article reference is made to hyoid bones. It might be fitting to say a few words about these interesting and important organs without which we would suffer much privation in not being able to enjoy the sound of our own voices or those of our talkative friends and neighbors; our pet would not greet us with his friendly bark and our neighbor's cur could not mar our nocturnal rest, which would surely be another great privation.

The hyoid apparatus is an essential part of the larynx and tongue system, the hyoid bones being embedded in the tissues at the base of the tongue, partly surrounding the larynx and taking part in its operation.

These bones also control, to a great extent, the movements of the tongue. As we look at the mounted skeleton of the wolfhound, we are to assume that the tongue is hanging far out of the open mouth, as is usually the case with a running dog. How different is the horse, who runs with closed mouth, breathing through widely dilated nostrils. Unfortunately, perhaps, for the osteologist, there are no bones in the dog's lolling tongue to add facial expression to the skeleton. To some extent, however, the hyoids come to our rescue. On close examination of the mounted skeleton it will be seen that these bones are thrust forward into the back of the mouth.

Whereas if the tongue were withdrawn into the closed mouth, the hyoid bones would move back more into the throat.

Now passing to the other extreme let us consider the caudal vertebræ. Without this appendage, which is regarded by many as an undesirable accessory, our



THE MOUNTED SKELETON OF "SYSONBY"

Twenty years ago "Sysonby" was known as one of the finest of race horses. The skeleton shown here is on exhibit in the American Museum and illustrates the flexed position somewhat the same as that illustrated by "Man o'War" on the opposite page. By comparing this skeleton with that of the wolfhound shown on page 547, it is easy to see how much more extreme is the action of the dog

happy and demonstrative friend would be robbed of his chief power of expression by which he so eloquently conveys to us his feelings of joy, remorse, or fear. While the tail of a living wolfhound does not so successfully express his emotions as does that of most breeds, to the osteologist it is really a boon, for, when the animal is running fast, the tail is apt to switch from side to side in an interesting manner. This justifies the placing of a few artistic curves in the caudal vertebræ of the mounted skeleton which, I think it will be conceded, adds much to the esthetic value of the exhibit.

It is hoped that exhibits of this nature may overcome a popular prejudice against collections of skeletons, and that the American Museum's osteological hall may become increasingly interesting and valuable, not only to the casual visitor but also to the student, the anatomist, and the artist as well.

"MAN O'WAR"

The greatest of all race horses. This picture was taken three months after his owner, Mr. Samuel Riddle, had taken the animal from the race track



the collection. Negotiations in the conferences between Doctor Andrews, Minister MacMurray, and the Cultural Society having failed to bring about an agreement, Doctor Andrews cabled to President Osborn and the matter was taken up in Washington with the Chinese Ambassador, Dr. Chao Chu Wu, a graduate of the University of London, and with the State Department through Secretary Stimson and Assistant Secretary Nelson Johnson. For several weeks conferences were held in New York, in Washington, in Peking, and in Nanking, with an idea of securing a modification of the terms formulated by the Cultural Society. With the authority of the Trustees, President Osborn renewed and extended the offer he made during his Peking visit in 1923 to establish a natural history museum in Peking out of the materials collected during fifteen years of exploration in China and Mongolia, provided the government would set aside a building for the purpose; also to take two Chinese students into the field to be selected by the Geological Society of China; also to bring a qualified Chinese student to this country for a year's education in Columbia University and the American Museum in the whole art of vertebrate palaeontology with the expectation of establishing this historic branch of science through highly trained students in China. The Trustees of the American Museum treated the matter as one of prime importance between the government and educational system of China and the government of the United States. This point of view was strongly sustained by Secretary Stimson. Finally a conference was held in Peking between Minister MacMurray, Doctor Andrews, Foreign Minister Wang, and representatives of the Cultural Society in Peking, at which the Chinese condition of a co-director was waived by the Cultural Society, but the other conditions remained substantially the same. On receiving cabled information to this effect, President Osborn instructed Doctor Andrews to abandon the expedition of 1929, to send all the American members of the party back to the United States, to remain himself in Peking, to retain the equipment, and to push forward as rapidly as possible the writing of the initial volume of the published series.

Meanwhile ten boxes of the 1928 collection arrived in this country on July 1, 1929, and the fossils are now being prepared in the laboratory of vertebrate palaeontology. The remaining twenty-seven boxes which were held by command of the Cultural Society, were shipped from Shanghai on June 26 and are now on their way to this country. It is expected that Assistant Chief Granger and Messrs. Young and Thomson will return to the

Museum in September and will immediately take up work on the restoration and description of the collection of 1928 which will occupy the entire winter.

The President and Trustees of the American Museum will take up through the State Department at Washington arrangements for the field expedition of 1930. Minister Chao Chu Wu is confident that a bill will be introduced in the Chinese Legislature distinguishing between geologic specimens including fossils and petrifications and flint objects representing the palaeontology of man, all of which belong to the world of science, and objects of ancient art, sculpture, and pottery, all of which belong to the early history of the great races of China and Mongolia. President Osborn strongly supports the world-wide movement for the retention of these objects of ancient art and archaeology in the country in which they originated. He also very strongly supports the system of free scientific exploration which has prevailed through all the civilized countries of the world since the year 1754, when the first French exploring parties made collections of fossil mastodons on the banks of the Ohio River, which were sent back to France for description by Buffon and other great naturalists who rendered the close of the Eighteenth Century so illustrious in the scientific history of France.

THE latest word from the Columbia University-American Museum African Expedition states that the party has now arrived in the Kivu district, where it has established its base camp.

ANOTHER expedition is being sent into the South American field by the American Museum on October 24, when Messrs. Gilbert Otley and H. E. Anthony sail for Mollendo, Peru.

This expedition is made possible through the generous financial assistance of Mr. Otley, who was a backer of the Museum's Porto Rico and Virgin Islands expedition of 1926 and a volunteer assistant in the field. Mr. Anthony, curator of the department of mammals, is in charge of the expedition, and Mr. Otley will assist in making collections of mammals, taking photographs, and recording observations.

The primary purpose of the trip is to make a biological reconnaissance through southern Peru, Bolivia, Chile, Argentina, Paraguay, Uruguay, and southern Brazil. Localities of especial significance, the places where the types of new species have been taken, will be visited, and collecting will be carried on to secure topotypes (specimens from the same locality as the type) for the Museum series. Because the Museum lacks mam-

mals from these key localities, such a collection of topotypes will be especially valuable as the basis for comparisons on the mammals of the whole southern half of South America.

The field observations made by the party will be of great assistance to Mr. Anthony, not only for the identifications and reports upon mammals already in the Museum, but also for the data which will be gathered for future field work in South America. Because of improved modern methods of transportation, the expedition will be able to carry out an itinerary which not many years ago would have required a much greater expenditure of time than the five or six months now planned.

The expedition will use railroads and automobiles for moves of any distance, and mules or horses for the side trips into the more inaccessible regions. One of the items in the plan is the gathering of accessory material for the Mt. Aconcagua group, the studies for which were made by Dr. Frank M. Chapman and F. C. Walcott at the base of Mt. Aconcagua in Argentina. The group shows the condor and will be a feature of the Hall of Birds of the World. It can be completed in the near future after the specimens of the shrubbery, grasses, mosses, etc., have been collected.

THE Sanford-Legendre Expedition has returned to New York after a nine months' collecting trip in Abyssinia. Most important of the material collected by the party are eleven specimens of nyala. Many fine specimens of other mammals were also brought back, including an Abyssinian red wolf, Soemmerrung gazelle, tora hartebeest, kudu, waterbuck, aard-wolf, and oryx. About 120 birds were also collected.

NATURAL HISTORY hopes to publish an account of this expedition in a later issue.

AN expedition has left the American Museum for Yucatan to collect the mammals of that Mexican state and to explore the numerous caves of the country for remains of fossil animals. These caves occur chiefly in a low range of limestone hills known as the "Yucatan Sierra."

The expedition, which will be in the field about three months, is supported by the Angelo Heilprin fund, and consists of Robert T. Hatt and his wife, Marcelle Roigneau.

THE American Museum has sent Myron Ackland, of the department of mammalogy, to the Okefenokee Swamp of southern Georgia to collect a representative series of mammals from that region. The territory is one of the few regions left within the borders of the United

States where natural conditions little altered by man's agency still prevail. Its mammalian fauna offers to the collector a range in size from the tiny shrew to the comparatively huge bulk of the bear. One of the objectives of the trip is the round-tailed muskrat, *Neofiber alleni*. It is also hoped that the fairly uncommon Rafinesque bat, *Nycticeius humeralis*, will find its way into the Museum's collections.

THERE has recently been devised in the department of herpetology and experimental biology of the American Museum, a method of infiltrating whole animals with paraffin in such a way that they retain their original color and form. Mr. William G. Hassler left in September for Santo Domingo, where he will employ the new method for the first time in the field. Mr. Hassler hopes to obtain several large species of lizards and snakes, as well as a number of frogs. These will be prepared in the field in such a way that they may be infiltrated when the expedition returns to New York. Mr. Hassler hopes to work out the life histories of several rare lizards while securing the exhibition material. He will also send live reptiles back to the Museum for study in the new laboratories of experimental biology. The expedition is supported by the Angelo Heilprin Expedition Fund.

THE Bernheimer Expedition.—Mr. Charles L. Bernheimer, who has led a number of American Museum expeditions to southern Utah and northern Arizona, during May and June, accompanied by Mr. Barnum Brown of the Museum staff and Mr. Earl H. Morris of the Carnegie Institution, visited the region in the triangle formed by the junction of the San Juan and the Colorado rivers. On previous expeditions Mr. Bernheimer explored the country south of the San Juan River, making important archaeological discoveries respecting the Basket-Maker and other early types of civilization in our Southwest. The expedition this year located additional Basket-Maker remains and cliff dwellings belonging to later culture periods in the Southwest.

Among the finds of special interest were extensive carvings on the walls of a cliff in Moki Cañon, at least one thousand feet above the cañon floor. Some of these carvings appeared to be sun symbols, others appeared to be mountain sheep, and others were unexplainable shapes.

It is a curious fact that the Indians living in that country during the Basket-Maker period did not use the bow and arrow, but were dependent upon darts thrown with an atlatl. Mr. Bernheimer found the skins of mountain sheep, well

preserved in the dry caves, in which the wounds made by atlatl darts were plainly visible.

Also, in one of the burial caves was found a mummy in good condition, together with ears of corn, golden-brown in color, baskets, and other articles used by the person in life.

THE department of anthropology of the American Museum, jointly with the Carnegie Institution, carried on explorations in Cañon del Muerto, Arizona, during July and August. The field work was in charge of Earl H. Morris of the Carnegie Institution, but formerly connected with the Museum. The camp of the field party was located near the famous ruin known as Antelope House, and the excavations were in the adjacent parts of the Cañon. The major portion of the work was the excavation of a burial cave opposite Antelope House in which were unmolested remains of the Basket-Maker period in the pre-history of the Southwest.

From these excavations were secured a fine series of specimens representing the Basket-Maker culture as it flourished in the Cañon. Further, the information provided by this site gives a clear picture of the part the Basket-Maker culture played in the development of the later cultures occupying the Cañon.

The find of special interest, however, was a unique burial. In this case the body of the deceased, together with his belongings, were placed in a stone crypt, carefully sealed. As a result, the clothing and other grave objects were perfectly preserved. The body seems to be that of an old man wrapped in two cotton blankets, covered with a robe of feather cloth. Attached to the grave bundle were many hanks

of cotton yarn, the strands of which have a total length of more than two miles. Accompanying the burial were five baskets, five pottery vessels, a bowl, and a planting stick. The stone crypt containing the body was roofed over with timber overlaid with matting, cedar bark, and earth. The ceiling was so complete that no dust had worked its way into the cavity, nor had the contents been disturbed by rodents or insects. Another interesting feature is that the pottery found with the body is of the well-known Mesa Verde type, and the nearest ruin in the Cañon accompanied by such pottery is more than half a mile distant. This find not only yields unique specimens for our collection but also gives us for the first time a complete costume for the Basket-Maker period.

These explorations were made possible by the generosity of Mr. Ogden Mills.

THE first detailed geographical study of Cañon del Muerto, Arizona, was made this summer by Edward M. Weyer, Jr., special field assistant in the department of anthropology. In addition to this work he carried on geographical investigations to determine the extent of possible agricultural lands used by the prehistoric inhabitants of that Cañon. Mr. Weyer's map and geographical notes will be an important contribution to the Museum's knowledge of the ancient civilizations of the Southwest.

DURING the past summer Barnum Brown investigated caves in southern Nevada for prehistoric mammals, collected Pliocene mammals in northern Utah, and found two Jurassic dinosaur skeletons in eastern Utah.

IN THE FIELD OF NATURAL HISTORY

Education — Scientific Research — Conservation
Books — Meetings of Societies

PERCY R. PYNE

ON August 22, Percy R. Pyne, for twenty-nine years a Trustee of the American Museum and its Secretary for the past eight, died at his summer home, Upton Pyne. An account of Mr. Pyne's association with the Museum will appear in a later issue of NATURAL HISTORY.

ASTRONOMY

"THE Big Telescopes and What They Do" was the subject of the address at the first fall meeting of the Amateur Astronomers Association on September 18. Mr. James Stokley,

astronomical editor of *Science Service*, came from Washington, D. C. to deliver the address, which described his rambles among the leading American, Canadian, and European observatories.

"Our Friendly Stars of the Polar Night" will be discussed October 2 by Anthony Fiala, commanding officer of the Baldwin-Ziegler Polar Expedition of 1903-1905.

FREE classes in astronomy will again be open only to members of the Association this fall. Information concerning these may be obtained from the secretary, Miss M. Louise Rieker.

EDUCATION

THE American Museum, in expanding and developing its educational activities, will take a further step this year by initiating "Cultural Courses for Teachers" of both elementary schools, and high schools and colleges. The Board of Education in New York City requires of its teachers thirty hours of cultural courses, and these courses at the Museum are designed to give the thirty hours' credit. They are free to teachers in the public schools of New York City. At the end of the course a paper of not less than 5000 words may be submitted in place of an examination.

For the teachers of elementary schools "A Cultural Course in Geography" is offered on Tuesday afternoons beginning September 24 and continuing until May 27, 1930, under the direction of Mrs. Grace Fisher Ramsey. This series will be opened by Dr. George H. Sherwood, director of the Museum, with a talk on the "Plans and Aims of the Course." This will be followed, beginning on October 1, with a series of six lectures on astronomical geography; and in November and December by six lectures on the "Earth-crust and Its Changes"; then will come a series on "Life in the Zones," and the "Races of Mankind"; and on May 27, 1930, a summary of the lectures will be given in a talk on classroom application by Mrs. Ramsey. Each session will last one hour and will consist of discussion in the classroom followed by study and examination in the exhibition halls of material relating to the subject under consideration. The topics for this course are based on the new syllabus in geography and will be of great value to teachers for current classroom use. The sources of the lecture material are, largely, the various expeditions of the Museum in all parts of the world, and will embody the results of researches and investigations by members of the scientific staff as well as other scientists.

The course for high school and college teachers will open on September 25 with a lecture by Doctor Sherwood on the "Plans and Aims of the Course." This will be followed during October and part of November by six lectures on astronomy by Dr. G. Clyde Fisher, curator of astronomy. Section II, "The Early History of the World," will consist of six lectures: two on geology by Dr. Chester A. Reeds, curator of geology; two on mineralogy by Dr. Herbert P. Whitlock, curator of mineralogy; and two on fossils by Mr. Barnum Brown, curator of fossil reptiles.

Section III will be devoted to five lectures on anthropology by Dr. Clark Wissler, curator of anthropology. Section IV includes five lectures

on birds, to be given by Dr. Frank M. Chapman, curator of ornithology, and Dr. Robert Cushman Murphy, curator of oceanic birds. Section V will include a course of six lectures on "The Nature of the Living World," by Dr. G. Kingsley Noble, curator of experimental biology. The course will be closed on June 4, 1930, by a summary lecture on "Classroom Applications of the Course," by Mr. Paul B. Mann, associate in the department of education.

These courses will be open to those who may desire them and are not teaching in public schools upon payment of a registration fee of \$15. Checks may be drawn to the order of the American Museum of Natural History and sent to the Museum at 77th Street and Central Park West. Registration should be made before Sept. 25 either by letter or in person at Room 306 of the School Service Building in the Museum.

DURING the fall of 1929 several activities will be carried on for the children in the blind and sight conservation (partially blind) classes of the public schools and for the blind children in private institutions. Members of the department of education will give, as formerly, a program of ten lessons in geography, history, and nature study, fully illustrated by museum material. Groups of boys and girls from Manhattan, Bronx, Brooklyn, and Queens will visit the Museum, some of them only once but others as many as ten times. In the classroom of the School Service Building, where these lessons will be given, each child will be allowed to examine and handle the objects used as illustrative material. Under the guidance of a Museum instructor, some groups of partially blind children will visit exhibition halls related to the lesson given in the classroom.

In addition to the class work, the Museum plans to send study collections to the blind and sight conservation classes in the public and private schools. Of particular value to the teachers are the relief globes which are so modelled with raised land formations, sanded coast lines, etc., that totally and partially blind children can easily learn their geography lesson by "seeing" with their fingers. The department of preparation has just completed ten new globes which will be distributed this fall as permanent loans to the public schools. These, together with those already distributed, will supply geographical aids to every school where there is a blind or sight conservation class.

THE success of the June session of the Nature Training School which is held each year under the direction of the Coördinating Council

on Nature Activities, has led the Council, at the solicitation of numerous camp directors and nature couns'lors, to offer for them two parallel courses in Nature Training and Camping for the eight weekends of October and November at Cold Spring Harbor, Long Island.

The Cold Spring Harbor region, well known as a center of scientific research, offers exceptional advantages for nature study, as it includes sea water, both pure and brackish, with fresh water adjoining, with the consequent "transition zones." It provides in the sea water, muddy, sandy, and rocky bottoms, all within the action of the tides, as well as at greater depths. The region is protected, thereby assuring a very wide range of ecologic conditions with abundant flora and fauna. It is also interesting geologically.

The locality presents excellent opportunities for camp demonstrations, with its heavily wooded slopes and hills and sand dunes, as well as the famous Hempstead Plains. The Eugenics Record office and the Carnegie Station for Experimental Evolution and the New York State Fish Hatchery adjoin the premises.

The Biological Laboratory has placed Blackford Hall, with its dining room, sleeping apartments, and club room at the disposal of the Council for these week-end groups.

The programs in Nature Training and Camping are so arranged that a member may take either course and receive a certificate at the end of eight weeks. Students unable to attend the eight consecutive sessions may register for a minimum of four week ends or may attend a single session by special arrangement. The staff will include directors and specialists in various fields of natural science and camping.

Dr. Bertha Chapman Cady, executive secretary of the Coordinating Council on Nature Activities, with headquarters at the American Museum of Natural History, and Mr. Ben Solomon, Editor of *Camp Life Magazine*, 93 Remsen Street, Brooklyn, New York, are directing the courses, and will be glad to furnish full information regarding them.

FISHES

THE model of a rare and highly specialized deep-sea fish, *Regalecus argenteus*, the oarfish or herring king, constructed by C. Marguglio, has been placed on exhibit in the Hall of Fishes at the American Museum.

The specimen on which the model is based was cast ashore at Moeraki, New Zealand, in 1883. Its skeleton was mounted for the Otago University Museum.

This fish is remarkable for its extreme fragility and flatness in proportion to its great length, and

for its peculiar skull structure. It is particularly vivid in coloring, frosty silver with blue head parts and light crimson fins. The anterior dorsal fin rays are produced into a high crimson crest, and the ventral fins reduced to long filaments. *Regalecus* has seldom been captured and is probably responsible for some sea serpent stories.

FOSSIL VERTEBRATES

ERRATUM.—In the caption of the full page drawing that appears on page 507 of this number, illustrating Doctor Simpson's article on "Hunting Extinct Animals in Florida," one of the two animals pictured is called, by mistake, a capybara. This animal is a ground sloth.

UPON his return from Peking to the Museum, Curator Walter Granger, will immediately take up the preparation, arrangement, cataloguing and illustration of the valuable collection of fossil mammals made by the Central Asiatic Expedition during its season of 1928.

After a long delay, the collection is reaching the American Museum in two consignments; the first, of ten boxes despatched from Peking in April, is now being prepared, and the remaining shipment of twenty-seven boxes was sent from Tientsin in June.

All the materials in these boxes have been carefully worked over in the laboratory of the American Museum headquarters in Peking by our own staff of Chinese preparators under the direction of Mr. Granger and our chief preparator, Albert Thomson. After this careful preparation they were recovered with wrappings of burlap and splints fitting tightly to the sides of the bones but readily removable in the New York laboratory by the free application of water which dissolves the adhesive material applied in Peking. The results of this method of preparing in Peking and subsequent finishing in the American Museum are very gratifying, first, in the great economy of expense; and second, because of the utilization of our entire Peking force in the winter season who otherwise would be idle; and third, because of the relief in pressure on the overcrowded laboratory of the department of vertebrate palaeontology in New York. As rapidly as these specimens are being finished they are being placed on exhibition in the Central Asiatic Hall on the fourth floor, east pavilion, so that the public may see them within a relatively short time after their shipment from China. The first of these new 1928 arrivals has already been described by Curator Osborn under the name *Embolotherium*, signifying the "battering-ram" titanotheres. The second and third descriptions will appear shortly of the "shovel-tusker"

mastodont or *Ambelodon*. Owing to the delay in the shipment of these specimens from China, the American Museum was anticipated by the Leningrad Museum in the description of a "shovel-tusker" mastodont discovered in Chinese Turkestan and described by Dr. A. Borissiak of the Palaeontological Museum of Leningrad.

WHEN Dr. William Diller Matthew, F. R. S., was called from the head of our department of vertebrate palaeontology to a full professorship of the same subject in the University of California, it was agreed that he should return to the American Museum during his vacation periods of the summer months to continue his researches on the oldest fossil mammals of Tertiary time, chiefly from the famous deposits known as the Puerco-Torrejon of northern New Mexico. Through the Cope Collection purchased in the year 1894, the Museum acquired the large and unique series of fossil mammals of this region, amplified by the explorations of Wortman and

Granger. It is a bizarre world of life totally unlike the present. Through years of research Doctor Matthew has become a master of this subject and on the invitation of the Trustees he is preparing a memoir entitled "Revision of the Puerco-Torrejon Fauna of New Mexico" of which Part I was finished during the summer of 1928, the plates made up and the illustrations completed. During the present summer Doctor Matthew has completed the second part including twelve plates, about thirty-five text figures and between three and four hundred pages of manuscript. The chief feature of this year's work is the re-study of the strange large-clawed mammals known as 'tæniodonts' (from the Greek signifying 'banded-toothed'). He writes: The drawings "took most of Mr. Prentice's (the artist) time. I pieced the skulls and feet together more completely, and restored them in plaster so far as justified by exact knowledge. They give

us a much better idea of the real character of the four tæniodont genera. I was even able to make a restoration of the skeleton of *Psittacotherium*."

WALDRON DE WITT MILLER

ON August 7 Mr. Waldron Miller, associate curator of ornithology at the American

Museum of Natural History, died at New Brunswick, New Jersey, from injuries received a few days previous, when the motor cycle on which he was riding collided with a motor bus.

For twenty-six years Mr. Miller had been a member of the scientific staff of the Museum, giving to the institution and to numberless bird-lovers who have called upon him, the benefit of his unequaled knowledge of birds and of fauna and flora, particularly within a radius of fifty miles of Plainfield, New Jersey, his old home.

Since boyhood Mr. Miller had been a close student of birds. In his early twenties he attracted the attention of William Dutcher and

later of Dr. Frank M. Chapman, through whom he came to the American Museum. During all the succeeding years he continued his field studies with unflagging enthusiasm, spending every spare moment out of doors, studying the local birds in varying phases during the cycle of the seasons. He made himself familiar not only with the botany of the region where he worked, but also with the small mammals and reptiles.

Mr. Miller was a member of the committee appointed to draw up the classification for the new check-list for the American Ornithological Union, which was published by Wetmore and Miller in 1926 in *The Auk*. He was undoubtedly one of the best bird anatomists in America. During his studies and field trips he had gathered an enormous amount of information on the anatomy and pterylosis of birds, and his notebooks bear witness to his keen observations of the specimens that passed under his eyes for record



Photograph by James P. Chapin

WALDRON DE WITT MILLER
1879-1929

A member of the scientific staff of the American Museum since 1903

and preparation. He made a special study of woodpeckers and their allies, world-wide in its scope, as well as of the characters of parrots and numerous other families.

To Mr. Miller's colleagues at the Museum to whose requests for information and assistance in their work he never failed to respond by placing at their disposal his rich stores of knowledge, and to his many friends and admirers, the tragedy which has robbed ornithology of one of its leading students, is cause for profoundest sorrow and regret.

HISTORY OF THE EARTH

AN extended vacation during the past summer permitted Dr. Chester A. Reeds, of the American Museum, to observe the geological features at many interesting places in Austria and Germany. A month in the Austrian Alps afforded an opportunity to examine the Höhe Tauern Range, the Gastein, Nassfeld and Seebach valleys near Badgastein and Mallnitz, and the beautiful glacial lakes Zeller See in the Saalach Valley, Mond See, Wolfgang See and Königs See near Salzburg. At Zell am See the recently completed funicular railway, which carries passengers up 2000 meters, provided a convenient ascent to the top of the Schmittenhöhe, where an excellent panorama of the eastern Alps with their snow-capped peaks and glaciated valleys was to be had. Here the barren Steinernes Meer range, with reddish hue and turreted battlements, was more picturesque than the snow-capped peaks of the Höhe Tauern. The descent into the salt mine at Berchtesgarden revealed extensive beds of rock salt of variegated colors, which has been mined since prehistoric times and afforded a revenue for various governments for centuries.

In Germany special studies were made:

(1) of the loess, sand and gravel deposits at Mauer near Heidelberg, where *Homo heidelbergensis* was found in 1907;

(2) of the Sächsische Schweiz or Saxon Switzerland where thick sandstone deposits with marked erosional features are exposed along the Elbe between Dresden, Germany, and Tetschen, Czechoslovakia;

(3) of the varved clay deposits in the valley of the Havel River at Zehdenick, 60 kilometers north of Berlin. Numerous photographs were taken at the points visited while at Gastein, Mauer, Dresden and Zehdenick. Samples of the material were collected for the American Museum series.

INSECTS

RESEARCH work at the Mt. Desert Biological Laboratory, Salisbury Cove, Maine, has engaged the attention of Curator Frank E. Lutz, of the American Museum's department of insect life, most of the summer. His studies were chiefly

concerned with the flexibility of the case-building instinct of caddis-fly larvæ, those interesting aquatic creatures that make "houses" of sticks or stones, or of both, according to their species. His results will probably be published in a subsequent issue of NATURAL HISTORY. Through the kindness of Mr. Pratt, chairman of the department's Trustee committee, Doctor Lutz had with him a motion-picture camera with which he filmed the activities of various insects for the Museum's department of public education.

EXPERIMENTAL BIOLOGY

IN continuing the investigations on the cause of blindness in cave salamanders, the department of experimental biology of the American Museum extended its activities to a study of species which do not ordinarily become blind. Mr. Maurice K. Brady has been studying the rare Coastal Plain salamander, *Stereochilus*, a close relative of the blind species, *Typhlotriton*. The work was carried on in Winton, N. C., where Mr. Brady found the species dwelling in certain magnolia bog conditions peculiar to the white cedar and cypress swamp area of the southern Coastal Plain. He obtained a series of both adults and larvæ for the department.

Mr. Brady, who has made a special study of salamanders of the eastern United States and is a graduate of George Washington University, has recently joined the staff of the American Museum as assistant in experimental biology.

REPTILES AND AMPHIBIANS

A NEW appointment at the Museum is Mr. Charles E. Burt who has joined the staff as assistant curator of reptiles and amphibians. He is a graduate of the Kansas State Agricultural College, and during the past two years has been carrying on graduate work in the University of Michigan. Mr. Burt has made special study of the American lizards, and at the present time has ready for publication a revision of the race runners, *Cnemidophorus*, one of the largest and most difficult groups of lizards.

DURING June and July Mr. and Mrs. Charles E. Burt made an extensive collection of reptiles and amphibians in the Mississippi Valley, which included 784 amphibians and 209 reptiles, obtained in thirteen states and in a wide range of habitats. The most important material was obtained in the region of the badlands and the Black Hills of South Dakota, in the sandhills of northern and central Nebraska, and in the swamps of southwestern Louisiana. The American Museum has very few collections of reptiles and amphibians from the Middle West and this material adds important species to the collections.

NATURAL HISTORY AUTHORS

Gilbert C. Klingel is a field naturalist of Baltimore who has for a long time been interested in photographing reptiles and amphibians. The expedition which he describes in "Lizard Hunting in the Black Republic" was sent out under the auspices of the department of herpetology and experimental biology of the American Museum, and was financed by Mr. Klingel.

Although **Vilhjalmur Stefansson** has spent a considerable portion of his life in exploration in the Arctic and sub-Arctic, his wide interest in all polar exploration is evidenced in his former contribution to the September-October, 1928, issue of *NATURAL HISTORY* entitled "By Air to the Ends of the Earth."

"The Theoretical Continent," gives the reader a most interesting account of the gradual shrinkage of the Antarctic Continent under the steady advance of exploration.

To **S. Harmsted Chubb**, who tells "How Animals Run," is due the credit of having had the first inspiration to mount skeletons artistically and scientifically accurate at the same time. As a boy he spent most of his spare time in cleaning and articulating the bones of stray mammal specimens. This early interest developed with the years, despite the fact that he had to go into commercial work. His love of the art urged him continually to seek some connection which would enable him to devote his entire time to it, and he was led to show several of his mounted specimens to President Henry Fairfield Osborn who presently gave him an opportunity to do some work for the Museum. That was eighteen years ago. Today Mr. Chubb is known as the foremost authority and exponent of artistic expression in skeletal museum exhibits.

The story of "The Birds of Little Diomedé" is told by **Francis L. Jaques**, one of the artists on the staff of the American Museum's department of preparation. Mr. Jaques painted the exquisite sky background for the bird dome of the Bird Hall on the second floor of the Museum,

and the background for the dramatic shark group in the new Fish Hall, as well as that of the Panama bird group.

Mr. Jaques' remarkable artistic ability, self-trained, and his particular interest in birds, fit him especially to interpret an artist's reaction to the problems of museum group construction.

Myron Ackland since February of this year has been an assistant in the Museum's department of mammals. As is evident from his article, "Animals in Orchestration," he is not a firm believer in the ancient admonition that "A cobbler should stick to his last"; and it so happens that music is his avocation.

Mr. Ackland was formerly a student of chemistry at Ithaca, N. Y. During his studies in 1923 and 1924, he had the rare opportunity of making frequent visits to the studio of the late Louis Agassiz Fuertes, who engendered and fostered in him the interest in natural history which was ultimately to take first place in his choice of activities.

There appears on the *Natural History* Cover for this issue a reproduction in color of a painting by Mr. Arthur A. Jansson, of the rhinoceros iguana, *Cyclura cornuta*, the largest of the iguanid lizards. It is exceeded in length by the iguanas of South and Central America, but these never reach the weight of the rhinoceros iguana. The Iguanidae include the horned toads and the chameleons, as well as the greater number of American lizards.

After several years of work on the earliest mammals, in the Yale Peabody Museum, British Museum, and other American and European institutions, **George Gaylord Simpson** joined the staff of the American Museum in 1927. Since then he has devoted much time to the study of the extinct mammals of Florida. "Hunting Extinct Animals in Florida" is an outgrowth of these studies and of field work early in 1929 in cooperation with the Florida State Geological Survey and with Mr. Walter W. Holmes, Field Associate of the American Museum.

Facts concerning other contributors have been given in former issues.

NEW MEMBERS

SINCE the last issue of *NATURAL HISTORY*, the following persons have been elected members of the American Museum, making the total number 11,200.

Fellow

Mr. H. F. BENJAMIN

Life Member

Mrs. ORLANDO F. WEBER

Sustaining Members

Mesdames JOHN P. CHASE, ROBERT GRANT, JR.

Miss F. E. WICKHAM.

Messrs. ARTHUR PFORZHEIMER, DONALD F. TRIPP, RANDOLPH S. WARNER.

Annual Members

Dr. FLORENCE R. SABIN.

Mesdames CAROLINE W. B. ATKINSON, WM. A. AYCRIGG, JACK A. DRYFOOS, C. B. GAMBLE, THOMAS J. GODDARD, L. R. HARDENBERGH, CARL LANG, R. F. MORSE, CHARLES T. PLUNKETT, JR., ORLANDO B. POTTER, LEW WALLACE, EDMOND WEIL, W. P. WILLETS.

Misses KATHARINE BEEBE, MARGARET HENRY, M. ANNIE MILLER, JULIETTE WEDEGARTNER.

Dr. MAX STURM.

Messrs. J. HENRY ALEXANDER, JR., J. C. BOYERS, R. S. CARTER, H. EDWARD DREIER, H. S. FOLEY, JOHN GEMMELL, JR., JESSE R. GIBSON, MILTON PRICE HARLEY, RAYMOND HARVEY, EDMUND HOLLÖS, ABRAHAM LEICHTER, F. A. LOVE, CHARLES P. LUCKEY, PAUL MANSHIP, L. MCCORMICK-GOODHART, HUBERT McDONNELL, THOMAS J. MOORE, CHARLES A. STREULI, THOMAS J. WHITE, JOSEPH WIENER, GILBERT CONDON WOOD, JR., HERMANN WUNDERLICH, R. M. YOUNGS.

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Misses MARY BELL, CLARE C. CASEY, KATHERINE T. DEXTER, MARGARET STONE HARDWICK, JR., ETHEL S. KYLE, HELEN E. MYERS, FRANCES PRETTYMAN, LOUISA H. PUTNAM, L. C. STURGIS, CAROLINE WU.

Pastor A. P. FRANKLIN.

Professors H. M. MACKEY, S. D. PEAROS.

Doctors GEO. W. ACKER, H. A. BEAL, HARRY S. BULL, DEWITT S. CLARK, WILLIAM G. CURTIS, DANIEL C. DENNETT, RICHARD J. ELLIS, RALPH E. FISHER, S. B. FRACKER, ROBERT W. GILMAN, MELVIN RANDOLPH GILMORE, OLIVER H. HOWE, F. J. HURLEY, JAMES W. JAMESON, ELLWOOD R. KIRBY, CHAS. A. MCNEIL, ROBERT N. NYE, EDWARD PLUMMER, J. P. PRATT, E. P. RICHARDSON, ARTHUR H. RUGGLES, J. H. SCHLINKMANN, GEORGE C. SHATTUCK, J. A. SPEIGHT, JOHN K. STRECKER, FRANK N. WILSON.

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Master HOWARD MORGRIDGE.